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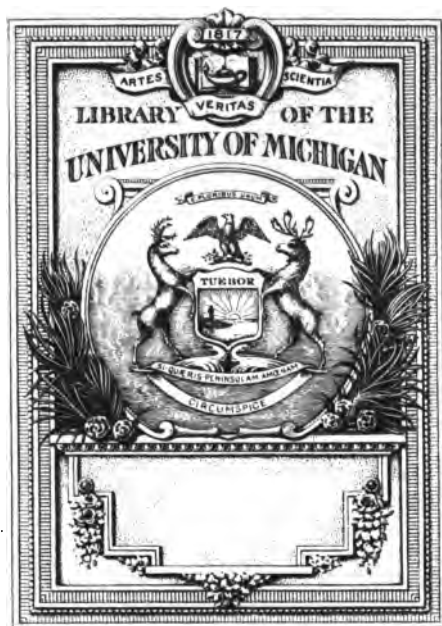
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"It is with great pleasure we introduce this book to the notice of our readers, for it was much wanted; and it is so well done that for a long time to come it will render unnecessary the publication of any similar work on fruit-culture."—*Gardeners' Magazine*.

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A PRACTICAL TREATISE
ON THE
CULTIVATION OF THE GRAPE VINE

BY
WILLIAM THOMSON
TWEED VINEYARD

NINTH EDITION



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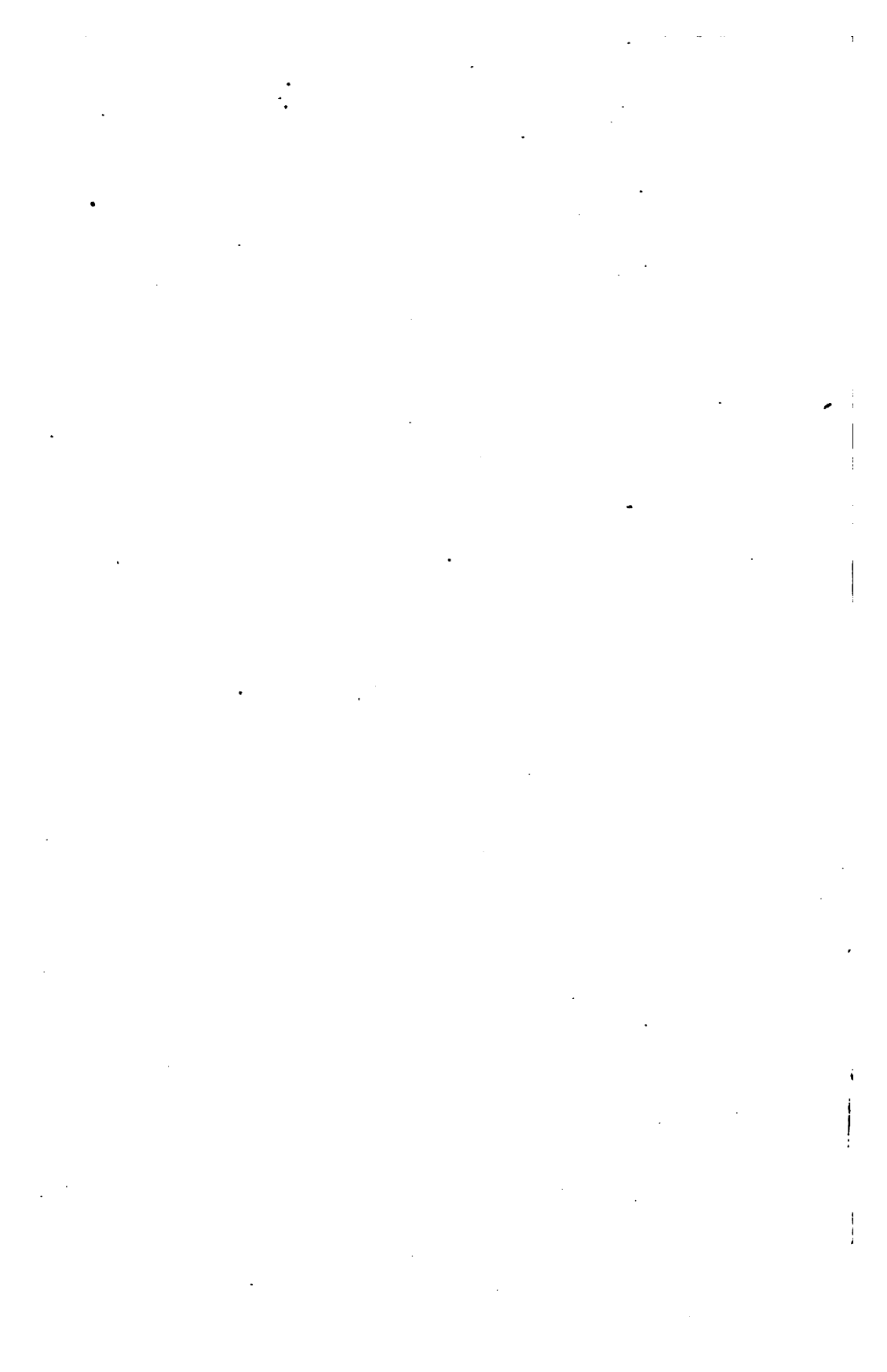
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PREFACE TO FIRST EDITION.

IN common with most gardeners similarly situated, I am often applied to, by amateurs and others interested in vine-culture, for advice and instructions on various points connected therewith; and much of the substance of this Treatise has been sent, at different times and in detached portions, in reply to such applications; and I may add that, in preparing it for publication in its present shape, I am but yielding to the urgent requests of not a few of those who profess to have reaped useful instruction from my private communications on the subject of which it treats.

I have endeavoured as much as I could to avoid technicalities, and to be as brief as possible, consistent with making the subject in hand clear; and I have resisted the temptation of being led into lengthened physiological explanations of the facts I deal with. All I recommend I have in my own practice proved to be correct, and can do it with confidence.

WM. THOMSON.

August 1862.

SECOND EDITION *published September 1862.*

THIRD EDITION *published April 1863.*

FOURTH EDITION *published January 1865.*

FIFTH EDITION *published June 1867.*

SIXTH EDITION *published May 1869.*

SEVENTH EDITION *published January 1871.*

EIGHTH EDITION *published March 1875.*

PREFACE TO EIGHTH EDITION.

THE fact that ten thousand copies of this work have passed into circulation, indicates the importance in the present day of the subject of which it treats, and has induced me to go most carefully over the last edition, and add whatever further and extended experience has led me to consider of importance to those interested in grape cultivation.

I have added a descriptive list of the most popular vines, the absence of which in former editions was by some readers considered a defect.

PREFACE TO NINTH EDITION.

WHILE I have carefully revised the present edition, I have not felt it necessary to make any alterations or additions to the directions it contains.

TWEED VINEYARD, *November 5, 1879.*

CONTENTS.

	PAGE
THE GRAPE VINE, ...	1
SHAPE AND SIZE OF VINERY, ...	2
ATMOSPHERIC HEAT OF VINERY, ...	5
BOTTOM-HEAT, ...	7
VENTILATION, ...	11
CONSTRUCTION OF VINERY, ...	12
SUBSOIL AND DRAINAGE, ...	13
COVERINGS FOR BORDERS, ...	14
COMPOSTS SUITABLE FOR VINES, ...	15
NEW METHOD OF PREPARING YOUNG VINES FOR PLANTING, ...	20
YOUNG VINES FOR PLANTING, ...	25
SEASON FOR PLANTING VINES, ...	29
VARIOUS WAYS OF PLANTING VINES, ...	29
TREATMENT OF VINES FIRST YEAR AFTER PLANTING, ...	33
THE SECOND YEAR'S TREATMENT, ...	34
THE FRUITING YEAR, ...	36
PRUNING VINES, ...	41
GRAFTING AND INARCHING VINES, ...	42
FRUITING GRAPE VINES IN POTS, ...	43
SELECTION OF VINES, ...	46
RIVAL SYSTEMS OF VINE CULTURE, ...	47

THE DISEASES VINES ARE SUBJECT TO, ...	53
RED-SPIDER, ...	56
RUST ON GRAPES, ...	59
MILDEW ON THE VINE, ...	60
WARTS ON THE BACK OF THE LEAF, ...	62
AIR-ROOTS ON THE VINE, ...	63
SCALDING, ...	63
STOCKS FOR TENDER VINES, ...	64
PACKING GRAPES, ...	65
KEEPING GRAPES AFTER THEY ARE RIPE, ...	66
AMATEUR'S VINERY CALENDAR, ...	68
EXPERIMENTS WITH VINES, ...	70
VINE-ROOTS, ...	79
OPEN-AIR CULTURE, ...	80
LIST OF VINES, ...	83
NOTES ON CELEBRATED VINES, ...	89
THE PHYLLOXERA VASTATRIX, ...	93

CULTIVATION OF THE GRAPE VINE.

THE GRAPE VINE.

THIS well-known plant, the *Vitis vinifera* of the botanist, has, during the whole historic period of the world, occupied in many parts of the earth a large share of man's attention. Its origin can be pretty clearly traced to Asia, though it is now said to be growing wild in many parts of the south of Europe ; and what are supposed to be indigenous species or varieties are found in America. It was probably first introduced into Europe by the Romans soon after the foundation of Rome. What may be termed a temperate climate is that most suitable for its cultivation. The soil it delights most in is a calcareous loam on a dry subsoil. The varieties of grape vines may be said to be endless. The French Government on one occasion made a collection of 1400 varieties in a nursery at the Luxemburg, and this was supposed to be only a moiety of those in cultivation in France alone.

The cultivation of grapes has at the present day assumed an importance in this country which, fifty years

ago, no one could have contemplated—partly owing to the increase of wealth, but chiefly in consequence of the duty being off glass; so that now a vinery has become a necessary adjunct to every villa residence, and is no longer confined to the walled-in gardens of the great of the land. And as these pages are principally intended for the guidance of the proprietors of the former, who are not supposed to employ scientific gardeners, I shall endeavour to make myself as plain and easily understood as possible; and the directions I purpose giving will be founded chiefly on my own practice, from which I will also draw any illustrations I may think necessary as I proceed.

SHAPE AND SIZE OF VINERY.

These may be as various as the tastes and means of their proprietors, and all produce good grapes; at the same time, there are forms and sizes which both philosophical deduction and experience have proved to be the best for given purposes. When one of these is the production of early grapes, there is no form of vinery so suitable as what is known as a “lean-to,” with a due southern aspect, of which fig. 1 is a section; the general construction and heating of which will be referred to under those heads.

Where the wish is to have late grapes—by which I mean grapes ripe in the end of August, to hang till February or March—the span-roofed form is the best and most economical, and should be placed with one end to the south and the other to the north. Fig. 2 is a section of the most elegant design of this description of vinery, though, from the nature of the top ventilation,

FIG. 1.

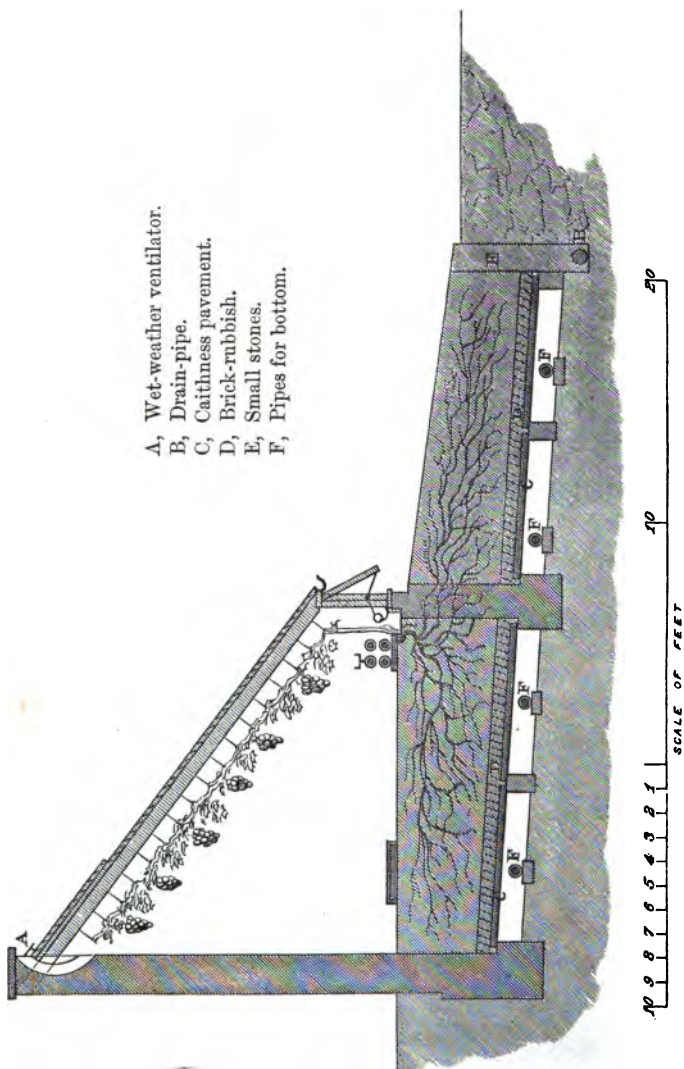


FIG. 2.

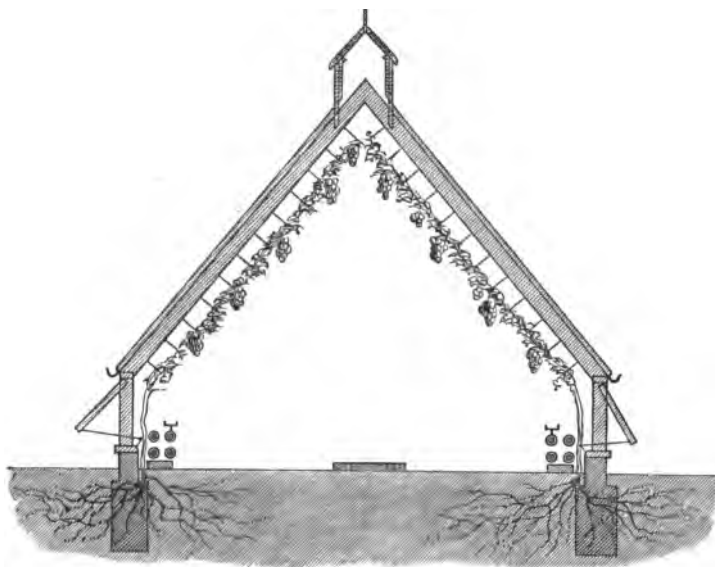
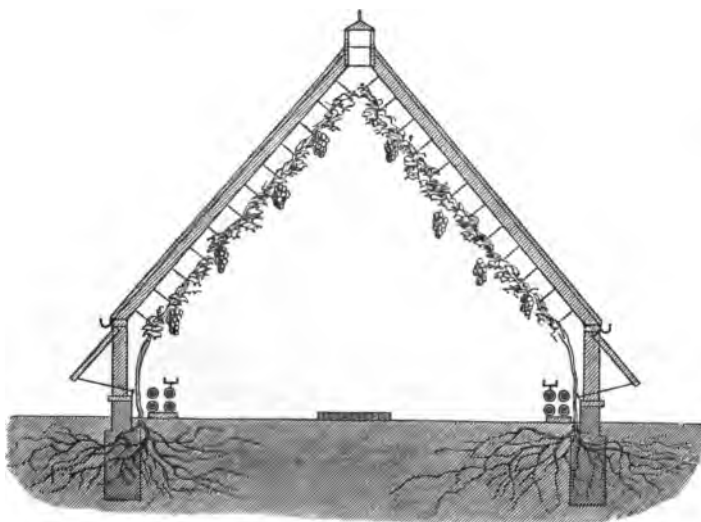


FIG. 3.



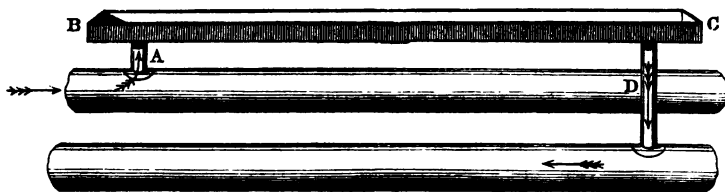
it is much more expensive than fig. 3, which, for practical purposes, is equally good, the only difference being the more finished and sprightly appearance of the former as compared with the latter.

ATMOSPHERIC HEAT OF VINERY.

At the present day there is no question that the best means for supplying this is hot water in pipes 4 inches in diameter. And let me here guard against the mistaken economy which is so often practised, of fixing too limited an extent of radiating surface to throw off a given amount of heat. This leads to the constant stirring of the fire to keep the water in the pipes as near the boiling-point as possible, entailing a far greater expenditure of fuel than if there were a third more pipe in the house. And it is well known to gardeners that a given heat from a moderately heated surface is more congenial to vegetation than the same heat derived from a more limited but highly heated surface. My own experience goes to prove that, in a vinery where grapes are expected to be ripe in March or April, there should not be less than one superficial foot of radiating surface for every 16 cubic feet of air the house contains. One foot in length of 4-inch pipe presents about one superficial foot of radiating surface. This would be something like four rows of pipe round front and ends of a vinery 13 feet high at back, 2 feet in front, and 13 feet in width, which are the dimensions of the early vineries at Dalkeith Palace, where a steaming-tray and ventilator, as shown in figs. 4 and 5, are also used. The tray is admirably adapted for supplying moisture to the atmosphere of the house, and is so far self-acting and regulating, that when the pipes are

at the greatest heat, and the house at the highest temperature, it gives off the greatest amount of moisture, and *vice versâ*. The ventilator (fig. 5, page 11) is a plan I have devised and used during winter for letting a constant stream of air into the house, which, before it escapes

FIG. 4.



STEAMING-TRAY.

The water flows in the direction indicated by the arrow, ascending by the small pipe A into the tray, and by gravitation along the tray from B to C, descending again into main circulation by the other small pipe D.

amongst the foliage of the vines, must of necessity become as hot as the atmosphere of the house. To this mode of admitting a constant stream of air previously heated into our early vinery, I attribute to some extent the extraordinary fine flavour of early grapes we began to cut on the 1st of January 1862.

With regard to boilers, I think it unnecessary to say much; their name is legion, and many of them are good. My own observation has led me to prefer those that expose the greatest heat-absorbing surface, not *under* the fire, or by the *side* of it, but immediately *over* it, provided always that their construction is such that every portion of their heat-absorbing surface can be swept clear of soot and ashes daily; for if these are allowed to gather on the boiler, they will, as non-conductors of heat, destroy its heating power to the extent of the surface they cover.

As a rule, it is much the safest plan to employ a respectable hot-water engineer to erect the heating apparatus, subject to specifications drawn by some one practically acquainted with the degree of temperature required, and the extent of pipe necessary to that end, the contractor to be bound to keep the whole in working order for one year after erection ; and if at this date the boiler is sound, and the joints and valves all right, the inference is that they will continue so for many years.

The pipes should be painted a dull black colour, as being that most suitable for radiating heat.

The best stop-valves are those made by Messenger of Loughborough.

BOTTOM-HEAT.

Gardeners have for many years felt that it was exceedingly unnatural to place the branches of the vine in a high temperature, while the roots were in the cold soil of the border outside the house, and they have had recourse to various expedients to remedy this clearly-recognised evil. Hot fermenting dung has been applied to the surface of the border, which did some good, more by its negative than its positive action, in so far as, if the heat from it did not penetrate the border to any depth, it at least, if applied in autumn, prevented the escape of the heat the border had derived from the sun during the summer. Wooden shutters, and in some instances glass, have been laid on the surface of the border to prevent the radiation of its natural heat. All these methods were well known to be very defective ; and it is only of late years that the heating of vine-borders from beneath by means of hot-water pipes, as shown in fig. 1, has placed the temperature of the roots as com-

pletely under the gardener's control as that of the branches has always been. Where the expense of stone pavement for covering the pipes is an objection to its use, the same end may be arrived at by first laying the pipes on pieces of half-inch round iron, resting on a smooth stone surface, at intervals of 9 feet apart. These bits of iron will act as rollers, and enable the pipes to expand and contract without the risk of "drawing" the joints. The pipes should then be covered with a small brick drain full of loopholes on each side, taking care that none of the covering bricks rest on the pipes. From these loopholes hot-air drains should be run right and left with dry bricks, or by using common drain-tiles, on the top of which 6 inches of brickbats should be laid, and then the turf, as already recommended. I find that the application of the bottom-heat for eight days raises the temperature of the border to 60°; and when this is indicated by the underground thermometer, the heat may be shut off, and will only have to be applied for a similar period when the vines are setting.

While the sixth edition of this work was being prepared for publication, a keen discussion, which originated in the columns of the 'Gardeners' Chronicle,' extended itself to the whole horticultural press, as to the advantages or disadvantages of artificially supplied bottom-heat for vine-borders from hot-water pipes placed under the borders, either in chambers or amongst rubble. My own opinion, founded on experience, is, that the subject scarcely admits of discussion, so evident are its advantages if used with discretion, as every other appliance of the sort ought to be.

In the month of May 1868 I planted a cucumber-house with young vines, principally from eyes the same year.

Their roots were confined to a border inside the house, $4\frac{1}{2}$ feet wide and 18 inches deep. This border was heated by two rows of 4-inch pipes under pavement. There were no means of turning off this bottom-heat. Under one end of the pit there was a tank for collecting rain-water 9 feet long, where there was no bottom-heat. There were two vines planted in this division—one a white Frontignan, the other a Royal Muscadine. During the summer these two vines did not make the progress the others of the same kinds did where they had bottom-heat. And the following year the difference was far more remarkable. In consequence of the house being used for forcing strawberries and French beans, the vines were started at a higher temperature than they ought otherwise to have been. The bottom-heat soon rose to 95° , and for a few days it was 100° . Those that had bottom-heat broke quicker by fourteen days, showing far more fruit than those that had it not, and were set and ready for thinning while those in the cold border were not in bloom; nor was their foliage much more than half the size of the same sorts of vines where they had the bottom-heat. I give this as an example of the good effect, as far as it goes, of bottom-heat for vines when applied to an extent that many utterly condemn. And I confess that if I had had a stop-valve on the bottom-heat pipes, I would have moderated the heat as compared with what it was.

The mere heating of the soil of the border by these appliances is not the only advantage that results. There is the additional and important one of the constant passage of air through the soil, forced up through it when heat expands that in the air-drains and interstices amongst the brickbats, and down through it when the air in the drains cools and contracts.

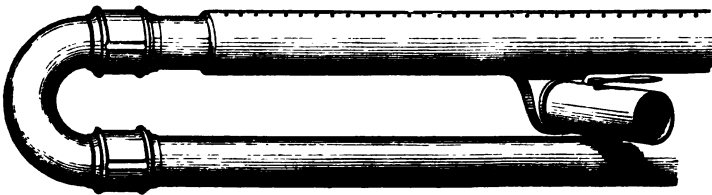
When the difficulty of getting a boiler fixed at a sufficiently low level to heat the pipes for warming the border cannot be overcome, as must often be the case where the country is level and the drainage bad, the best substitute is, to make all the arrangements as to air-drains I have described as necessary when pipes are laid, and to connect these subsoil air-chambers with the atmosphere of the interior of the vinery by a series of drain-pipes along the front of the house near the hot-water pipes. Along the back wall of the vinery construct an underground air-drain, to be connected by a series of pipes, 4 inches in diameter, with the general underground air-chambers of the border. From this drain another series of pipes should be carried up the back wall some 7 or 8 feet, when they should have openings into the interior of the vinery ; and if the flue from the boiler is made to run along the back wall in such a way as to heat the air in the upright air-drains, it will become lighter and escape into the general atmosphere of the house ; while at the same time a current of air will pass down the front air-pipes already referred to, at a lower temperature than that escaping from the outlets in the back wall, but sufficiently warm to be of great benefit to the roots of the vines. This arrangement has the additional advantage of keeping the air in the house in constant motion. There is also the possibility of making such arrangements in forming a vine-border as to admit of the application of dung-linings for warming the soil. It is, however, only necessary to have heat applied to the roots, as here described, in cases where grapes have to be forced early. If the vines are not started till the beginning of March they will do perfectly well without it, as is evident from everyday experience.

VENTILATION.

This is a point of great importance, and, in very early forcing, one of considerable difficulty; for it not unfrequently happens that, after a severe frost at night, requiring hot pipes, the sun breaks forth in the morning and raises the temperature of the vinery beyond a safe point, while at the same time the wind may be piercingly cold. In such circumstances there is no alternative but to open the top ventilators, when the hot air will rush out; but at the same time another current will rush into the house, of air too cold to be admitted amongst the tender foliage of the vine with safety. To modify this evil, it is a good plan to have a light wooden frame made to fit the ventilating opening, and over this frame to tack a sheet of perforated zinc, or a double piece of Hawthorn's hexagonal netting. This will break up the rush of air into a great many small streams that will more readily mingle with the hot air of the house, and get so far heated before it reaches the foliage.

It would be no safer to admit the cold air by the front ventilating-sashes to take the place of that making its exit by the top ones, unless some means were employed

FIG. 5.



HOT-AIR VENTILATOR.

to take the chill off it before it is discharged into the body of the house. For this purpose I have designed what I have termed "The Hot-Air Ventilator" (fig. 5).

This apparatus consists of a sheath of copper placed over a row of the front pipes. The diameter of this sheath is one inch more than the hot pipe it encloses, consequently there is an open space of half an inch all round the pipe inside the sheath. This cavity is fed with fresh air from the exterior of the house by a pipe 5 inches in diameter, which springs from the lower surface of the sheath, and passes through the front wall of the house to the external air. There is a valve in this feed-pipe to modify the supply of fresh air at pleasure. In the upper surface of the sheath is a double row of small holes, so that the moment the cold air comes into the chamber round the pipe, and gets hot, expanded, and lighter, it makes it exit through these holes into the general atmosphere of the house. In our early vineries the valves are kept open constantly, both night and day, with great advantage to both fruit and foliage.

CONSTRUCTION OF VINERY.

As a rule, whether for early or late forcing, I prefer a good-sized house,—say, height of back wall, 15 feet; width of house, 15 feet; height of front sashes, 2 feet; length, 40 feet. A house of these dimensions has a good length of rafter, which enables the vines to carry a large extent of foliage, and become vigorous plants as compared with those confined to a short rafter; and the roof presents an angle of about 35° to the sun—a very suitable one for a vinery; while the length of the rafter will be about 19 feet. If the roof is constructed of sashes and rafters, the sashes should be 6 feet wide, so as to afford space enough for training one vine-rod up under each rafter, and one in the centre of each sash:

if all of astragals, as is sometimes the case, the rods may be regulated as to distance from each other at pleasure. The wires to which the vines are tied should not be nearer the glass than 16 inches, and should run at right angles with the rafters. When they are too close to the glass, as is often the case, the leaves come in contact with it, when they get killed by being, as some say, scorched, but in reality frozen. These wires should be within 10 or 12 inches of each other. There is no pathway so suitable, either for a vinery or peach-house, as iron-grating. In a house of the dimensions I have here indicated, and where grapes are to be ripe in April, there should not be less than 300 feet of 4-inch pipe for surface or atmospheric heat, in addition to which there should be a steaming-tray, which gives off fully as much heat itself as one row of pipe. The front and ends of the house should rest either on pillars or arches, so as to give the roots free access to the outside as well as inside border. The front row of pipes should be 18 inches from the front wall, and the permanent vines planted equidistant from front wall and pipes. The supernumerary vines should be planted 12 inches inside the pipes.

SUBSOIL AND DRAINAGE.

Where the entire border is heated by hot-water pipes covered with Caithness pavement, as shown in fig. 1, any excess of water that may fall on the border will descend through the joints of the pavement to the chamber the pipes occupy, from which a drain should be laid down to remove it at once. But where bottom-heat is not so applied, and where the subsoil is of a cold, wet, ferru-

ginous clay or gravel, it must be well drained, so as to prevent the rise of spring-water, and to remove all the rain-water that percolates through the border. This done, a layer of concrete, 4 inches in depth, should be laid over the whole surface of the intended bed of the border, taking care that it has a slope of 1 inch in the foot towards the front, where there should be a good drain to draw off all water that finds its way to that point from the surface of the concrete, and from the drains under it. On the concrete, as well as on the pavement, when the latter is used, a layer of 4 inches of rough brick-rubbish should be spread, then a course of turf with the grassy side downwards, after which the compost may be wheeled in to form the border. Where the subsoil is honest clay or clear gravel, concrete is not necessary. No rule can be laid down for width of borders: I think it is ample if the width outside the house is the same as that inside. The depth inside should be 3 feet; immediately outside, in front of house, $2\frac{1}{2}$ feet; and at the extremity, 2 feet. A border formed to these dimensions will have a considerable declination towards the south, which will enable it to throw off the winter rains better, and during summer it will receive more benefit from the sun's rays than when flatter.

COVERINGS FOR BORDERS.

This is a matter of much importance, especially in the case of early forced vines. Where the border is heated by hot-water pipes from beneath, all that is necessary is to lay some dry leaves, dry fern, or other litter, on the surface of the border to prevent radiation, and to cover it over with such as tarpaulins, oiled calico,

wooden shutters, old hothouse lights, or straw thatch—any material that will throw off the greater portion of the winter rains will answer the purpose. Where vines are not started till March, any advantage they might derive from a permanent covering would be more than counterbalanced by the loss of the sun's rays on the border during the day. In such a case, a covering of coarse cloth of some sort thrown over the border in the evening and removed in the morning would be beneficial till the warm nights of June set in. Grapes that ripen in autumn and have to be kept till spring are supposed to keep better by having the border the roots of the vines are in kept dry during the winter. I have, however, kept Lady Downes Grape hanging on the vine till May without a covering of any sort on the border.

COMPOSTS SUITABLE FOR VINES.

As previously remarked, the soil the vine thrives best in is a fibry calcareous loam, taken, not more than 3 inches deep, from an old sheep or deer pasture. Such soil should consist of about 65 per cent sand, 30 per cent clay, and 5 per cent of chalk, with an abundance of vegetable fibre, giving it the character of what gardeners know as friable turfy loam. When the sand is in excess of what I have indicated, it may be termed sandy loam ; when the clay is in excess, clayey loam. The preparation it should receive, and the ingredients that should be added to it, depend on its qualities in these respects. I will give an example of how it should be prepared, supposing it to be of the medium quality I have described, and others applicable to cases where either sand

or clay may be in excess. It may not be improper that I should remark here, that I have known fine vineries erected, and every preparation made calculated to produce good crops of grapes, till the question of going into the park for the proper description of loam had to be mooted, when the proprietor very naturally refused to allow the breaking-up of any of his old pasture, and the gardener had to have recourse to unsuitable soil, probably out of a plantation, where in every morsel of decaying wood there were the spores of fungi that were certain one day to destroy the vigour of his vines, and in many cases kill them altogether.¹ This is a difficulty that, with proper explanation to a reasonable employer, might be removed, and no harm done to the sheep or deer pasture. Say that in some spot most out of view and the soil suitable, the necessary quantity of turf was cut, and thrown with the grass side downwards, there to lie till the first dry frosty day, when it should be carted and stacked while in a frozen state. It is of much importance that soil for a vine-border should be taken during sharp frost, which drives the wire-worm to a depth the spade does not reach, and the pests are left in the field. For every cart-load brought out of the park, let a load of old rich garden-soil be laid down in its stead, be properly levelled, sown with a good cast of lawn-grass seeds and white clover, raked in, and have a roller run over it. If cattle are in the park at the time, a sheep-net can be run round it till it is green, when the net may be removed; and, the sheep and deer being the

¹ June 22, 1867.—A gentleman has just sent me a portion of the soil from the borders of four new vineries he has erected and planted this spring. It was taken from a turfy bank on which an old hedge grew, and I find it one mass of fungi—in such a state that it is impossible a vine or any other plant can thrive in it—caused, no doubt, by the decaying roots of the old hedge.

judges, it will be by far the most esteemed portion of the park for many years.

After this digression, let us suppose that the necessary quantity of suitable loam has been obtained, neither clay nor sand being in excess of what has been indicated, and that it has been stacked for six months, so that the grass is dead and the whole mass dry. Then let it be cut down with a spade, and broken up with one of Park's five-tined forks in preference to the spade, and thrown into a ridge, taking care to have it kept so that a tarpaulin or some other cover can be thrown over it to keep it dry. To ten carts of this soil add two of lime-rubbish—old plaster is preferable, as it contains hair, itself a good manure; one cart of thoroughly-charred wood, including any wood-ashes that may be amongst it; one cart of well-decomposed farmyard manure; 4 cwt. of broken bones, about one inch square; and, if to be had, 2 cwt. of horn-shavings may be added. Have the whole mass turned over several times, but always in dry, if possible frosty, weather, before it is wheeled in to form the border. This I can guarantee, from my own experience, will form a safe and fruitful vine-border; the addition of more manure might give stronger canes for a few seasons, but they would be much more liable to suffer from excess of wet in winter; and when it is considered how easy it is to feed the roots of the vine with liquid manure at the seasons when it is most required, I can see no reason, but the opposite, in favour of making vine-borders so rich as some advocate. When the soil is what is termed clayey loam, I would add the same ingredients to it, with the addition of two cart-loads to the ten of burned clay, which acts as a mechanical disintegrant, and keeps the particles of clay from

getting too close together, and so preventing the entrance of air into the soil, or the percolation of water through it. Of burned clay, Dr Lindley, in his able work, 'The Theory and Practice of Horticulture,' speaks to this effect: "Why burned clay should be better than that sort of soil in its ordinary condition is sufficiently obvious—its texture is changed. In its natural state it is so adhesive that air cannot get into it. It also offers great mechanical opposition to the passage of roots through its viscid mass, and hence it is exclusively inhabited by a coarse and worthless vegetation. Burning changes all this; the particles of clay lose their adhesiveness, and this gives a new character to the soil, which offers freedom to the entrance of air and exit of water, and which crumbles readily away beneath the advancing roots of any race of plants. But that is not all the difference betwixt burned and unburned clay: the roots of plants which it previously contained were unable to decay, and are now by fire reduced to their saline constituents, and so enrich the soil; and, moreover, the burned particles of clay acquire the power of absorbing ammonia from the air, and holding it within their pores till showers fall and wash it into the land, where it immediately acts as a nourishing food for plants."

When the soil is what is termed light sandy loam, add all the ingredients except the burned clay, which need not necessarily be used, as the compost will be porous enough without it, though it will do no harm; give double the quantity of farmyard manure, and half the quantity of lime-rubbish I recommend for clayey loam.

As many who are anxious to grow grapes may not be able to obtain access to a sheep or deer park to procure

the loam I have described as most suitable for vines, I will here indicate a compost that will grow excellent grapes, and that is at the same time within the reach of all who possess a garden. Take of the ordinary garden-soil one-half the quantity required to make up the border; lay it in sharp ridges to get a winter's frost. Then procure one-fourth the quantity required of the parings of turf-edgings and the scourings of ditches, with the addition of a few barrow-loads of clay; then get together all the clippings of hedges, the prunings of fruit-trees, with any other refuse of a kindred nature; build all into a heap and set fire to it, piling it round with the turf-parings and clay already referred to, till the whole forms a cone, with a fire in its centre. After it has burned for some days, and the whole has got thoroughly hot through, and the wood all charred, extinguish it by pouring on the hot mass the drainage of cow-byres, pigsties, or any similar liquid; and while still in a hot state, mix it with the common garden-soil that has been for some time in ridges. To every ten loads of this compost add one of old lime-rubbish, one of farmyard manure, 4 cwt. of bones about an inch square, 2 cwt. horn-shavings, when they can be procured, and if they cannot, let superphosphate of lime take their place. Let the whole be turned over more than once, but always in dry weather, and it will form an excellent compost for vines.

For reasons that all gardeners understand, I would not make the whole width of the border at the time the vines are planted, but would make up, say, 6 feet inside the house, and the same width outside. This will be found ample for the roots of the vines to run in for the first year. The second year I would add 3 feet inside and 3 out, and at this rate annually till the allotted

width is made up, going back to the points of the roots at every such addition, and raising them carefully into the newly-added soil. In this way the compost, instead of becoming sour from being trod upon, and watered while as yet no roots are in it, will be added just as the roots are ready for it; and every gardener knows with what gusto vine-roots rush into fresh turfy loam as compared with that which is sodden and livery; and it is well known, also, that soil gets more readily into this state when it is much in excess of the requirements of the plants that grow in it; and it is frequently more convenient, where soil and labour are scarce, to make the borders in this way, than to have so much to do at once.

NEW METHOD OF PREPARING YOUNG VINES FOR PLANTING.

The admitted fact that many vines, after having attained to full fruitfulness, rapidly culminate and decline, has occupied my thoughts a good deal, with a view to the discovery of the cause, and a remedy for it, ever since the sixth edition of this work passed through my hands; and I have come to the conclusion that the cause must be sought, more in the defective preparation of the young vine before it is planted, than anywhere else. I know there are those who blame what is called the restrictive system of cultivation for this admitted evil. I differ with them, and will proceed to describe what the ordinary treatment of a young vine is, up to the day it is planted in the border, and what is likely to be its progress for some time afterwards.

To begin at the beginning—a vine-eye is placed in,

say, good rich soil, in a small pot, and the pot is plunged in smart bottom-heat in January. In that position it soon starts a bud upwards, and five or six fine strong roots downwards into the rich soil. These soon reach the sides of the pot, and begin to run round it in a coil. Rapid progress is made by both root and branch, and when the vine is, say, 12 inches in height, it is shifted into perhaps a 10-inch pot, the soil being rich, that the canes may be strong. In this rich soil, especially with bottom-heat, the roots, though few in number, soon find the sides of the larger pot, and begin to coil round it again.

I am only dealing with the root preparation, and say nothing of the evils resulting to the vine from overcrowding, and the absence of plenty of light and air on the foliage.

The cane becomes ripe, and the vine is supposed to be ready for planting the following spring. The border being ready, made up of good rich loam, with the usual admixtures, the vine is turned out of the pot, and then comes the difficult task of disentangling the roots, and spreading them out in the border. By the time this is properly done, there are left but some five or six long roots that reach half-way across the border in all the directions they are laid. The task of disentangling has been so difficult that all the young fibry roots, if there were any, have been torn and destroyed. The vine thus planted makes progress while the stored-up sap in the stem and few roots that survive lasts, when a halt is called till roots are formed to supply more. This generally takes place from the points of the extended roots, and as a rule they go straight in the direction in which the old roots are laid, for the most part outwards in an opposite direction from the top of the vine. In

three years, if the border is all made up in that time, they have got to the extremity of the prepared soil, and enter something of a very different character generally. Sometimes there is an exception to this, and all goes well; but it is wrong to presume on such a contingency. From all who may say that my description of what takes place in the circumstances described is not correct, I appeal to whoever may have removed the soil from the roots of old vines, and especially if the borders have been originally made of rich compost. They have found in the original border a few great, long, bare roots, that had rushed rapidly in early life through the prepared soil, into that which is not at all congenial to their health. Consequently, in some six or seven years, vines of great promise become suddenly subject to shanking, and get weaker and weaker, till they are voted a failure.

I will now describe the method I adopted in the spring of 1870 to obviate the evils I have pointed out,—and seeing that to myself it involved a large commercial interest, I only adopted it after clear conviction that the usual system was wrong; and I am happy to say that, others being the judges, nothing could be more successful as far as it has gone. I had vineries to plant requiring about 700 vines, of various sorts, and I prepared them as I will now attempt to describe. Over the pavement of the pit of a pine-stove, under which were hot-water pipes, just sufficient to give a bottom-heat of 70°, I laid a course of thin fibry turf; on this turf some four inches of fine turfy loam, but no dung of any sort. In this soil, about 6 inches apart each way, I placed the vine-eyes in February. They started, and made progress in the usual way, sending out a few fine large fleshy roots. When the plants were 6 inches high, I had them all cut

round, so as to isolate the piece of turf on which each vine sat. By this process all the points of their strong tap-roots were cut, and during sunshine they flagged for a day or two. In the week each plant was lifted by having a flat trowel shoved under it, when it was seen that every root so cut had emitted more than a score of small fibry rootlets. They were then placed on a similar bed of turf, and soil placed round them, but this time 9 inches apart each way. They suffered no check, but grew rapidly. When 3 feet high, they were cut round again, as in the first instance, and allowed to stand a week, when they were raised on a spade, and planted in the borders where they are to fruit. This time all the edges of the cube of fibry soil they were growing in were one mass of small roots, more like the roots of a privet-hedge than a vine. On the 29th of May a span-roofed house of Lady Downes, 200 feet long, was planted with vines prepared as I have described; on the 20th of June, a Muscat-house of same size; on July 5th, a third house, of same size;—and I am unable to say that I ever saw vines do as well before; while an examination of the border they are growing in shows that their roots retain the character thus forced upon them, and by only adding about 3 feet of border inside and the same outside to each side of the house annually, they have been compelled to retain their multitudinous character;—the result being that, at the end of the first season, there was scarcely a vine in a hundred that differed in strength from its fellow, and all from 3 inches to $3\frac{1}{2}$ inches in circumference, and as ripe and hard to the apex of the houses, 20 feet from the ground, as if they had been there for years.

Such of the vines as I did not require for planting

these borders I had carefully lifted and placed in pots of 2 inches greater diameter than their balls, and the inch all round filled with fibry loam ; and they formed an immense mass of fine active roots all round the outsides of the balls in the pots, and the canes were of fine strength, and thoroughly hard and well ripened. When vines prepared as described come to be planted, there is no occasion to shake out the ball, for there are no coiled roots ; all they require is that the roots round the sides of the balls should be disengaged a little with a pointed stick, and the soil of the border filled in around them, and I guarantee the result will be most satisfactory, all other necessary attention being supplied. I readily admit that to train young vines in the way I have attempted to describe is much more expensive than the usual method, but I am certain the expenditure will give an ample return for many years.

The system of growing young vines either for fruiting or planting in very rich soil with bottom-heat, and as close together as beans in a field, cannot be too severely condemned ; soft pithy wood and bad constitutions are the certain results. Nurserymen, however, should not be blamed for this while purchasers rush to where the price is the lowest, altogether irrespective of any such considerations as those I have called attention to. If the cane is a good size they are satisfied.

It is a great mistake to suppose, as some appear to do at the present day, that young vines that are grown "without the aid of artificial heat" are any better than those that have had such aid : the very reverse is the case. Nothing will compensate for the absence of thoroughly-ripened wood, and in Britain this can rarely be attained from eyes the first year without the assist-

ance of fire-heat; and no vine is fit for planting that has been two years in a pot, when compared with one that has been well managed one year. While I give this method of preparing vines for planting, I think it right to retain what I have written on the subject in former editions, as many may not have the means of growing them as here described. At the same time, I am sure the system will commend itself to the ordinary common-sense of my readers.

YOUNG VINES FOR PLANTING.

There are various opinions as to the best way of preparing young vines for planting. I have used plants from layers; from eyes, two, three, and even four years old; from eyes one year old; and from eyes struck the year they were planted,—and have found them all succeed; but I would give a decided preference to the two latter, and especially to good, sound, well-ripened vines one year old, from eyes either home-grown or procured from some respectable nurseryman, who is careful about their names being correct—who does not grow them in bottom-heat, and as thick as they can stand, in dark houses, which is sometimes done. They may be struck in bottom-heat; but after they are shifted into the pot in which they are to be sold, they should have no bottom-heat exceeding the atmospheric temperature of the house they are grown in; for I have invariably observed that the soft forced roots vines make in bottom-heat, such as they receive when plunged in hot tan, die off during the winter, and are of no service to the plants when planted the following spring; and though the canes, in consequence of being forced on in this way, may look better

than those grown without bottom-heat, they are not so in reality. Far better have a well-ripened though smaller cane, with a pot full of hard, fibry, active roots, that will survive the winter, and come early into action in the spring. My objection to the plants being crowded in dark houses, as they are often to be seen, is, that many of them get no direct light from the sun on their foliage; and, though they may make good-sized canes, cannot be properly ripened, and become fit foundations for healthy fruitful vines. When vines are thus crowded during their season of growth, and are set outdoors, perhaps against a wall or hedge, to stand till sold, they are sure to receive permanent injury from even a moderate degree of frost, such as would not injure well-ripened canes. As a rule, it is injudicious to expose young or old vines, ripened in this country, to more than 10° of frost at any time.

When the vines are to be struck from eyes, I have found it best to select the eyes from well-ripened wood, from a house where the grapes have been cut in June or July. I cut the wood right across, about half an inch on each side of the eye, and then take a small slice off the side of it, longitudinally, opposite the eye, making the cuts as clean as possible. I then have 4-inch pots filled with light turfy loam, and a small portion of thoroughly-decayed leaf-mould. When the pot is filled with this soil, I make a hole that would contain a walnut in the centre of it, which I fill up with fine white sand, and in the centre of the sand the eye is deposited, when a little of the compost is placed over it, and the whole receives a watering. I have found that cuttings form callus sooner in sand than in loam, and throw out more roots also. When thus potted in January, they may for a

time stand in any convenient corner of a peach-house or vinery just started. By the 1st of February they should be plunged in tan, or some other medium affording a bottom-heat of 90° , and placed as near the glass as possible. With an atmospheric temperature of 55° at night, rising to 70° by day, the buds will soon appear above the soil. Contemporaneously with the development of leaves, roots will be emitted all round the calloused edges of the bud into the soil. At this stage see that they have what water they require to keep the soil moderately moist; and to guard against the formation of what I will term strong bottom-heat roots, give the pots a shake with the hand, so as to leave a cavity all round them, from which any excess of heat may escape. When the plants have four leaves developed, raise them out of the plunging material they are in; and though they will not make such a rapid growth as if left in the bottom-heat, they will make a much safer one. The pots by this time will be getting pretty full of roots; but on no account shift the plants into larger pots till they have begun to grow afresh after the stand they make, when the available nutriment in the bud is exhausted, and before the young roots and newly-developed leaves have begun to supply more. If shifted before this second growth begins, they frequently stand still for a month, and often end in premature ripening at the neck, and refusing to start into a healthy second growth at all.

The size of pot they should be shifted into depends on what they are intended for. If for planting out, an 8-inch pot is sufficient; if for fruiting in pots the following season, the size should not be less than 8 inches or more than 14 inches. I have found a compost the same as that recommended for the borders answer ad-

mirably for vines in pots. When potted, they should for a few days be shaded, as the roots must suffer more or less in the process, and are not prepared to supply the foliage with the needful sap to resist the demands made upon it by a powerful sun. In March or April the temperature and general treatment as to airing should be the same as what will be recommended for the first year they are planted out in the border. They must never be allowed to flag for want of water; give liquid manure once a-week. Whether vines are intended for fruiting in pots, or for planting out the following season, the laterals, as they appear, should be stopped at one joint. These laterals will break again, and should be pinched, so as to leave another joint. The best position for such vines to grow in is in the full blaze of the sun. I have grown them trained up under the rafters of a pine-pit, and found them prove very fruitful, and also against the back wall of a pine-stove; but they will do well in any situation where they can have vinery or pine-stove heat, be regularly watered, have the full influence of the sun, and be kept free from red-spider. When the canes become brown, and all the symptoms of ripening show themselves, the whole of the lateral branches may be cut off, care being taken not to injure the leaves that spring from the main stem, as their office is to fill out the buds that are to show the young bunches of fruit next season. When fairly ripened—say in September—and the leaves are getting an autumn tint, they may be removed and nailed up against a wall, provision being made that they do not suffer from want of water. From this position they should, on the approach of frost, be removed to an airy shed, peach-house at rest, or some other shelter, where they can be kept cool, and at the

same time protected from severe frost. Thus prepared, they are fit either for fruiting in the pots they are in, or for planting out in a border. If wanted for the former purpose, they may be cut back to 6 feet, including pot. Their roots should never be allowed to get dry during their season of rest, as is sometimes the case, nor should they have much water.

SEASON FOR PLANTING VINES.

I have planted vines at various seasons from the 1st of March till the beginning of September, and have found them all succeed well. The time of planting has often to be determined by circumstances. When year-old vines have been procured, the first week in April is a very suitable season for planting, as vegetation is then becoming active. I will therefore suppose that at this date the soil has been wheeled into the house during dry weather, and carefully and equally levelled to the required height, making allowance for the subsiding that is sure to take place in the case of soil containing so much organic matter. This allowance should not be less than 6 inches. Say then, that, before the vines are planted, the soil is exactly to the level that is desired when the border has settled down, there will thus be a margin left for 6 inches of soil to be laid on during the process of planting.

VARIOUS WAYS OF PLANTING VINES.

While I have planted vines in nearly every possible way, and have found them all succeed well, at the same time there are some methods preferable to others, and I

can strongly recommend the following, from my own experience of it. It is probably in its details new, but it only requires to be described to commend itself to all who have any knowledge of such matters. I had a large house to plant, chiefly with Muscats, in April 1864. I had a stock of one-year-old plants in 8-inch pots by me; I cut the rods back to 4 feet in February, and allowed them to stand in a cold peach-house till the 13th of April, when the border was ready for their being planted. I shook all the earth from their roots, and spread them out on the soil of the border, one vine to each rafter, and 6 feet apart, covered the roots with 6 inches of soil, and gave the whole a good watering with water at a temperature of 150°, and covered the surface with an inch of dry soil, to prevent, to some extent, the escape of the heat communicated to the border by the warm water. The vines were just bursting their buds when planted, and instead of adopting the usual practice of stopping, or rubbing off all the buds but one or two, I allowed all to grow, and tied them carefully to the wires; by this means I had in some instances ten rods to one vine, all of which, during the season, ran to the top of the house, and partly down the back wall, a distance of 30 feet, and many of these rods were as strong as ever I had previously seen a single rod from a vine the first year it was planted. In January 1865, when they were cut down, the whole house was a perfect thicket of wood. I cut back all these vines to within a foot of the front sashes, and trained up two rods from each the following season, fruiting them in 1866; and I need not tell those who know that a plant makes roots in proportion to its leaves, that vines treated as I have described had an

enormous excess of roots formed in the border, as compared with others treated on the one rod and pinching system, and that the bearing-rods they made were in proportion to the extent and vigour of their roots in the soil. I measured one of them in December that, when planted in April, was not thicker than a writing-quill, and I found that it was $3\frac{1}{2}$ inches in circumference, and had ten rods perfectly ripe to the top of the rafters, a distance of 21 feet. If, instead of permanent vigour and productiveness, an immediate return were the object aimed at, I have no hesitation in saying that such a vine would have yielded 50 lb. of grapes the following autumn.

In planting vines, some advocate the laying of a considerable length of the stem in the soil; I do not. I think it an evil, and that the vigour and extent of roots that a vine will make depend, not on the length of stem laid in the soil, but on the spread of healthy foliage it can get fairly exposed to light and air. I have planted others in the following way: I cut back the plants to within one inch of the surface of the soil in the pot, allowed them to break and grow a yard of young wood, and then planted them so as to lay an inch of the young wood in the soil, when a tuft of roots starts from the junction of the old and new growths; but when there is any danger of fungi being in the soil, this plan should not be adopted. In the case of planting young vines struck from eyes the same year, the roots can sometimes be disentangled and laid out sufficiently, without reducing the ball; and when this can be done, it is best to let it be so, as, by that means, less of a check is given to the plant. In 1858 I planted a vinery on the 15th of May. This house is 110 feet long. I prepared 75 vines for it

in the following manner : I had as many pieces of thin turf cut as there were vines. The turf was in pieces 2 feet long and 18 inches broad. I laid five or six pieces of hazel rods longitudinally under each turf, and across their ends I tied another piece with bits of wire, thus forming sort of turf-trays. On these I laid 2 inches of soil ; and after shaking out the vines, and pruning, and in some instances washing their roots, I laid them out on the surface of the soil, from one end of the turf, like the extended fingers of the hand, covering up with a layer of 3 inches of sharp soil. I placed them all, as close as the trays would admit, in the pit of an intermediate house, where they had a night temperature of 55°, and 65° to 70° during the day from sun-heat ; tied each to a stake, gave the whole a good watering, and covered all the surface with moss. This was done in March, and when they were planted in May, the whole soil was a mass of fine healthy roots. We removed one at a time, and planted them with care. They gave no indications of having received the slightest check. Twenty-four of these were Lady Downes and West's St Peter's. They were put one to each rafter, to form the permanent vines for the house. The others were chiefly Hamburgs, to be considered temporary, in as far as they were to bear a crop the next year, and then to be removed. One set of the latter was planted, one in the centre of each light, close to the front ; the other set along the centre of the house. Their progress was all that could be desired ; and the following year, 1859, the house produced over 400 bunches of grapes, without taking one from the permanent vines. The supernumeraries in the centre row were removed after the first crop, but some of those in the front row still remain. I may remark that out of

this house we cut black Hamburg grapes in August, and Lady Downes seedling grapes, perfectly plump and good, till April every year.

TREATMENT OF VINES FIRST YEAR AFTER PLANTING.

Where the ultimate object is to have vines brought as early as possible to a state that will bear what is termed early forcing—that is, to produce ripe grapes, say, in March or April—they should be planted in February, without waiting till they make young wood in the pots, and started with a night temperature of from 45° to 50° , rising with sun-heat 15° higher. Let the atmosphere of the house be kept moist by any of the appliances for that end, and let the canes be syringed twice daily with tepid water till the buds burst—after which, water in any other form than that of vapour should never touch them, unless, as sometimes happens in very dry summers, like that of 1868, the red-spider is more than usually prevalent, when it may be necessary to use the syringe, as directed under the head of “Red-Spider.”

In the case of vines that are to be the permanent ones, every lateral and leaf they produce should be allowed to grow the first season ; by this means a mass of roots will be formed in the border, that in their turn will send up fine strong fruiting-caness the second year. Those that are only the temporary ones, and that are to be fruited the second year, must have their laterals stopped at one leaf, and their leading shoots also stopped when they have grown 12 feet or so. This will plump their fruit-buds, and prepare them for fruiting the second year. As the season advances, and they get foliage developed, the temperature should rise, till in May it has reached 70°

by fire-heat at night, and it may be run up with sun to 85° or 90°. In giving air, let it be at the top of the house in the first part of the day; then, as the heat from the sun increases, admit a little at the front, but with great care in cold weather where there are no means such as I have previously described for heating it. As the season advances, say in August, give abundance of air in all directions. This will help to make the wood hard and brown; but be careful of the foliage till it decays naturally. The diseases and attacks from insects to which vines are liable, as well as the best means of preventing their ravages, will be treated of in subsequent chapters.

THE SECOND YEAR'S TREATMENT.

This begins with the cutting back of the vines, say in December; and in the case of those that are not to bear fruit, they may be cut to within 3 feet of the bottom of the rafter, where only one rod is to be grown from each vine; where two or more rods are to be grown from one, cut them to within 18 inches of the soil; those that are to fruit the second year may be left 8 feet long, and be allowed to bear eight bunches each, supposing them to have made canes $1\frac{1}{4}$ inch in circumference, and that the wood is well ripened and short-jointed, with the buds or eyes prominent. This done, the whole wood and glass of the house inside should have a thorough good washing, and the canes should be washed with soap and water with a brush, and painted over with a mixture composed of 2 oz. soft soap, 2 oz. flowers of sulphur, and 1 gill tobacco-water, to 2 quarts of water; stir the whole together, and add clay sufficient to give it the con-

sistency of paint, which will destroy any larvæ of red-spider or other insects that may be left on them ; but where no spiders have been on the vines during the summer, this painting may be dispensed with ; and it never should be applied after the buds begin to swell, as it will injure them. When painted, let them be tied to the wires, and give the surface of the border a slight prick over with a fork, but beware of going so deep as to injure the roots. Cover the surface of the border with horse-droppings to the depth of 2 inches when they can be had : watering over them enriches the border and feeds the roots, preventing rapid radiation at same time. On the 1st of February they may have fire-heat applied, beginning as in the first year in regard to moisture and syringing. As soon as the buds break, increase the heat at night to 60° , and by the time they have got some part of their foliage fairly expanded, increase it 5° more, running up 10° or 15° above this with sun-heat. The atmosphere should be kept sufficiently moist by sprinkling the border and paths, if there is no steam-tray on the pipes ; but avoid syringing the pipes when they are hot, as this raises a great cloud of steam for a few minutes, doing more harm than good. What the vine requires for its growth, with healthy foliage of good texture, is an atmosphere not arid, but certainly not steaming like that of a cucumber-frame. This year, the laterals that form on the young rods must be pinched at two leaves from the leading stems ; and those laterals that start on the 3 feet that was left of last year's rod must have any bunches they show picked off, with the exception of one or two that may be left to prove the variety, and be stopped, say at the fifth joint, and tied to the wires. When the leading shoot has gone half up

the rafter, it may be stopped, and then allowed to start again, and not stopped more till the autumn pruning. The laterals below the middle of the house must also be stopped every time they start beyond one joint. Vines started as early as these have been will be nearly ripe by the end of July, and at that date the laterals on the young wood that is to bear fruit the following year should be cut off close to the base of the stalk of the leaf that springs from the leading rod; but this leaf itself should be carefully preserved, as it will still be of service in laying up sap to plump the fruit-bud for next year. The house may now have abundance of air night and day, till the leaves become yellow and fall off in September, when the laterals on the previous year's wood may be cut back to an eye that will be found at the base of the said lateral, where it springs from the parent stem. The leaves should all be cleared off now, the rods cut back to 8 feet, and any loose bark on the previous year's wood removed; after which give them a good wash with tepid water and a little soap, and then paint with the same mixture as recommended for the previous year, if spider has made its appearance on the vines during the season. At this season every part of the interior walls of the vinery should be washed with *hot* lime whitewash, with a little sulphur stirred in it, and all the woodwork and glass cleaned thoroughly with soap and water well dashed into every corner.

THE FRUITING YEAR.

Vines prepared as has been recommended may be started on the 1st of January the third year. My practice with vines of this description is to collect as many

oak-leaves as will make a heap 3 feet deep on the vinery floor, where they soon become hot and give off a fine genial heat, which carries with it all the moisture required. Young vines, especially if very strong, are prone to start strong shoots at their points that will monopolise all the rising sap, and leave the others unsupplied. To prevent this as much as possible, sling the points of the vines down, so that they hang on a level with the part that is tied to the first or second wire, till all the eyes have made 3 inches of wood, when they may be fixed. If there are means of giving bottom-heat, it should be applied so as to raise the temperature of the border where the roots are to 60°. If this can be done, the heat from the hot leaves may be supplemented by the heating apparatus, so as to keep the atmosphere of the house at 50° by night, and 55° by day, rising 10° by sun-heat. With these appliances, and syringing with tepid water daily, the vines will soon begin to burst their buds; and as soon as it can be observed that there are two shoots starting from one eye, the weakest should at once be rubbed off with the hand, and syringing discontinued. In its stead a small portion of the hot leaves may be forked over daily; this will afford all the atmospheric moisture necessary till after the fruit is set. The moment the bunches can be distinguished, the heat should be raised 5° at night and the same during the day; and by the time the shoots have run out 3 inches, 5° more; and by a daily rise from this point, till, in the case of Hamburgs, and the free-setting class, it reaches 70° at night, when the grapes are in bloom. Muscats set best at 75° at night, and 80° of fire-heat during the day, and up to 90° with sun. My own practice is to take off all the bunches that show on a lateral shoot but one, and to

stop the lateral on which it grows two leaves or joints beyond the bunch, and to pinch all sub-laterals at the first joint, and to repinch them without leaving an additional joint. I consider this gives ample foliage for perfecting the fruit and keeping up the vigour of the vine; and it will be found to be as much as can be properly exposed to light, supposing the leading stems of the vines to be $2\frac{1}{2}$ feet (3 feet is not too much) apart, which is as close as ever they should be. When the grapes are set, it is necessary to determine the number of bunches to be left on such vines. My experience proves that eight bunches on each rod are sufficient, supposing such bunches to average, when ripe, $1\frac{1}{2}$ lb. each: of course the largest and best bunches ought to be left, and as equally all over the house as possible. None should, however, be left on the leading shoot,—which should not be stopped till it reaches to the top of the house,—this year.

It is difficult to give precise directions for thinning the berries; it must, however, be done as early as possible, after the grapes are set, in the case of the free setters; but in the case of Muscats it is best to wait till it becomes obvious which of the berries are properly set and taking the lead. Care must be taken not to injure the berries that are left in any way, either by touching them with the hand or scissors. Experience alone can teach how thin they should be: they should be so thin that every berry is able to swell perfectly without being jammed, and at the same time the bunch should be so firm that, when cut and laid in a horizontal position on the dish, it preserves the same shape as when hanging vertically from the branch. This I consider the perfection of thinning, and can only be obtained by experience

and a knowledge of the size of the various sorts of grapes, as well as of given vines of the same sort.

I consider 70° of fire-heat sufficient for grapes as a night temperature, except for Muscats when in bloom. I may here remark, that in March 1867 I had a house of this vine in bloom, and during the whole month the sun was only visible for about three hours, with rain nearly every day. I kept the fire-heat 75° by night and 85° by day, and every bunch in the house set like Hamburgs. No moisture was given, while they were in bloom, in any form; the forking over of the leaves on the floor was for the time discontinued; and at that stage, if a bunch received a shake in any way, a complete cloud of pollen flew from it. This is the whole secret of setting Muscats. When they are set, however, I let them fall back to 70° at night, and give a steady but not excessive moisture to the air, letting them rise with air on to 90° during the day with sun-heat. I make it a rule, except during severe frost, to keep the back ventilators open an inch, and the front ones half an inch during the night. This gives a supply of fresh air, and keeps the foliage healthy and of good substance, and more able to resist the scorching effects of the sun when it makes its appearance. On the other hand, a thin, almost transparent foliage, grown in a close, over-moist atmosphere, though it may have expanded to a large size, gets brown and destroyed by a few days of bright sunshine in May.

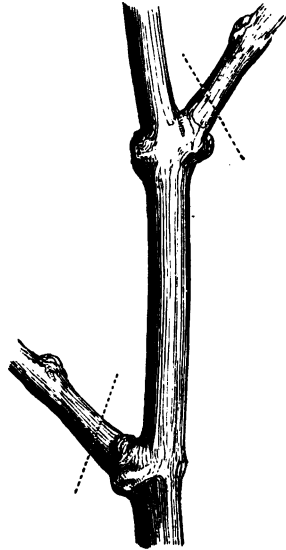
With regard to watering the inside border I have as yet said nothing, and will now remark that, if the bottom drainage is good, it may get a thorough soaking of soft tepid water when the vines are started, another after the grapes are set, a third when they are taking their second swelling, and a fourth when they begin to colour;

the three latter may be liquid manure. These should be no surface waterings, but thorough drenchings; and if the season is very dry, like that of 1868, the borders inside and out should be mulched with rotten dung and receive several extra waterings; unless this is attended to, where the soil is light and gravelly, red-spider is sure to injure the vines. In no case tread on the border when it is newly watered. I ought to have remarked that the leaves placed on the floor of the vinery may be removed as soon as the grapes are set, and before the second watering. The moment the first berry in the house begins to colour, the supply of air should be more liberal both by night and day, and the moisture less, where high flavour is aimed at. When the grapes are all cut, it is too often the case that the vines no longer receive that attention which they ought till their foliage ripens and falls off in the autumn. Immediately after the grapes are cut, the vines should get a good syringing with tepid water to wash off any spider that may be on their foliage, or any dust that may have settled on it. The border should have water enough to keep it moist—the inside border, I mean; for it rarely occurs that an outside vine-border requires water supplied artificially. In very hot summers a mulching of short dung will keep it sufficiently moist. All second growths the vines may make should be pinched off at once. If this matter is not attended to, and these after-growths are allowed to go on, the vines, instead of going to rest as they ought, will make a sort of supplementary season's growth, and will assert their right to rest at the period when they should be starting into growth. Many failures in early forcing may be traced to want of attention to this apparently trifling cause.

PRUNING VINES.

As will be seen by a reference to fig. 6, the only bud left to produce fruit the following season is the one at the base of the lateral shoot; and I prefer a pair of pruning-scissors to a knife for the operation of pruning. Those I use have a sort of back-action, and cut as clean as a knife. My objection to the knife is that, unless it is used with care, the half-inch of wood left beyond the bud is often split by its action, and the bud suffers in consequence; but this is a matter that care can easily avoid.

FIG. 6.



When vines are vigorous they not unfrequently bleed copiously when forcing commences, though they may have been pruned months before. This is a clearly-recognised evil, and many compositions have been recommended for preventing bleeding. Nearly all these I have tried, but none of them answered the purpose. I have now discovered a styptic which is so perfectly successful that I can, by its use, prune a house of vines in March, dress the wounds with it, and begin forcing the next day, without the loss of a drop of sap. It is manufactured by John Young & Son, Dalkeith, and sold by all seedsmen.

Though the young wood be regularly cut back to one eye, in the course of 10 or 12 years the spurs will

become long and unsightly ; and the best way to remedy this is to cut down a rod annually, beginning at one end of the house, running up a young rod in its stead till all have been renewed. By continuing this practice, the length or size of the spurs will never become an objection to the system. When vines have been trained on the old long-spur system, they can readily be converted to the one I recommend, by the same means as that for getting rid of the old spurs of the short-spur or close-cutting system ; and in order that the transition should interfere as little as possible with the supply of grapes, a few young rods can be run up annually till the whole wood in the house gets renewed.

GRAFTING AND INARCHING VINES.

When it is considered desirable to increase the varieties of vines in a house, the simplest way of doing so is either to graft or inarch them. For my own part, I prefer the latter method ; and by putting young wood to young wood, all that is necessary is to bring the vines to be united into a convenient position to each other, and to take a slice with a sharp knife off each, nearly half through their diameter, the wounds to be the same length ; then bring their wounds together, so that at least two of their sides or lips are in close contact ; then put a distinct tie above the wounds, and one below them, to enable you to undo the tie that is to hold the wounds together betwixt these two at any time, without the risk of destroying the embryo union that may be taking place ; then with soft matting thoroughly and rather firmly bandage the whole length

of the wounds. The vines will swell as they grow, and this bandage will have to be slackened occasionally, when the importance of the two ties first referred to will appear. The growth of the stock on which the new vine is inarched may be stopped at three joints past its point of junction with the new one. In nine out of ten cases the union should be complete in a month, when the bandage may be taken off, but the ties above and below retained for some time afterwards. When the young vine shows by its vigorous growth that it is deriving supplies of sap from its new parent, its connection with its own roots may be half severed, and by the end of the season cut off entirely. I have inarched young wood on to old, and old wood on old, with perfect success also. I do not consider grafting so certain a plan as inarching in the manner I have described; and besides, it leads to a good deal of bleeding when the graft is put on just as the old parent vine is started into growth. This bleeding can, however, be prevented by covering the junctions of scion and stock with the styptic.

FRUITING GRAPE VINES IN POTS.

As a rule, I do not consider this a profitable way of growing grapes, as compared with permanent vines planted in borders; at the same time, there are various exceptional cases where fruit can only be had so—as, for instance, the first year a vinery is erected, if the proprietor procures not only a set of vines to plant in the borders, but another set to fruit in pots, he may in this way have a partial crop of grapes in his house the first season. Or when a gardener has to root out and renew

a vinery, and at the same time supply grapes, he can have recourse to vines in pots. In this way I have grown two hundred bunches of grapes, in a house 30 feet long and 13 feet wide, the year I planted it with young vines. Sometimes grapes can also be grown in pots over the paths at the back of pine-stoves, and in similar positions, where borders are not available for vines to grow in; and it is by far the most judicious way of growing grapes for the months of April and May, for nothing exhausts vines so rapidly as very early forcing, and the expense of renewing borders and vines is very considerable, whereas a couple of dozen good pot-vines will give a supply for any ordinary family for these months.

It is also a very suitable way for amateurs who may have a small greenhouse near a town residence, where a vine-border cannot be made. They can annually purchase half-a-dozen fruiting vines, and train them up the rafters of their greenhouse, where they will bear fruit and at the same time afford a grateful shade to such plants as balsams, cockscombs, achimenes, &c. For the encouragement of such I may mention that, at the June Show of the Royal Horticultural Society of London in 1864, a medical gentleman, in Mount Street, Grosvenor Square, London, got a prize for black Hamburg grapes grown on the roof of his residence in a small greenhouse.

Vines suitable for pot-culture should be well ripened, strong canes either one or two year old, in pots not less than 10 inches in diameter, having been grown and ripened in the full blaze of the sun. A cane 6 feet long is enough for fruit, therefore they may be cut to that length. I have found it a good plan to knock the bottoms out of the pots, and set them either on some rich

soil in another pot or in a pit, into which they root vigorously and swell double the fruit they would do confined to their own pots. Give liquid manure occasionally.

Vines in pots are frequently grown for dinner-table decoration ; but I have seldom seen them look natural and well, as they are generally grown in large pots, and coiled round stakes. Fig. 7 is an illustration of the way I have grown them in Dalkeith Gardens for table decoration. When the vines are placed in heat, a small pot is slipped over the rod, and in this pot a neatly-made stake, painted green, is placed, and the soil filled in round it. Through this stake a set of strong wires are run at right angles with each other, to which the branches of the vine are tied, as shown. The small pot gets filled with roots by the time the grapes are ripe, when it may be detached from the large pot, and can be set in a small vase on the table, where the tree-like plant with fine pendulous bunches of grapes looks all that can be desired. I have had one of these vines fourteen days in the fruit-room, with nothing to support it but a small pot, without a flagged leaf, and the bunches as plump as when detached from the original roots in the large pot.

For growing in pots for table decoration, the black varieties have the best appearance, and especially the black Hamburg, Gros Colman, and black Alicante.

FIG. 7.



These are free bearers, and their fine black fruit contrasts well with the green foliage.

For general cultivation in pots, the following are suitable: Black Hamburg, Duke of Buccleuch, Foster's White Seedling, Royal Muscadine, White Frontignan, and Duchess of Buccleuch. The latter produces finer fruit grown in pots than it does any other way, and has no equal for flavour.

SELECTION OF VINES.

For a person who has one vinery only, and who does not mean to force early, the following twelve vines will be found suitable, and, with ordinary good management, will give grapes for six months from the first of August:—

- 3 Black Hamburg.
- 1 Buckland's Sweetwater.
- 2 Duke of Buccleuch.
- 2 Black Alicante.
- 1 West's St Peter's.
- 1 Lady Downes Seedling.
- 2 Gros Colman.

For early forcing the following are suitable:—

- 4 Black Hamburg.
- 2 Duke of Buccleuch.
- 1 Muscat Hamburg, on Black Hamburg stock.
- 1 Royal Muscadine.
- 1 Grizzly Frontignan.
- 1 White do.
- 3 Muscat of Alexandria.

For growing in heat to keep for winter use:—

- 6 Tynningham Muscat.
- 1 Kempsey Alicante.

2 Lady Downes Seedling.

1 Gros Colman.

1 Gros Guillaume.

For growing up the rafters of a greenhouse or orchard-house where little or no artificial heat is available, the most certain to succeed are :—

Black Hamburg.

Royal Muscadine.

Thomson's White Lady Downes.

Black Prince.

Black Champion.

Black Cluster.

Buckland's Sweetwater.

Grove-end Sweetwater.

To these, others might be added, but the selection given is sufficient for all ordinary purposes.

Where there are plenty of vineries, I would recommend such grapes as the Frontignans and Muscats to be grown in houses by themselves; at the same time they will do quite well as classed in the lists I have given.

RIVAL SYSTEMS OF VINE-CULTURE.

While I was preparing the fifth edition of this work for the press, a keen controversy was being carried on in the horticultural journals as to the merits of what is designated the "extension system" of vine-culture, as compared with the "restrictive system," one section of writers maintaining that the proper mode of cultivation, where long-continued vigour and fruitfulness are desired, was to allow one vine to develop and extend till it has filled the house with bearing-wood. Another section as confidently maintained that vines could be kept in perfect

health and vigour sufficiently long for all practical purposes on the "restrictive system" of culture—meaning by that a system which only supposes one or two bearing-rods to be trained from each vine, and where the method of pruning is what is called the close-cutting system, where the new wood is all cut back to one eye at the base of each lateral. Thus a question of such importance was raised that I did not feel justified in passing it by—apart from which, I had been asked my opinion of the merits of the two systems by numerous correspondents. These circumstances combined, determined me to devote a chapter to discussing the subject, believing, as I do, that there is much truth in what is said by the advocates of both sides of the question, as there generally is when sensible men discuss questions of this character. I may here remark that the question is by no means a new one to me; more than twenty years ago I frequently discussed it with the late Mr Peter Kay of Finchley. Theoretically, it must at once be admitted that the one-vine or "extension" system stands on vantage-ground. No one can deny that a tree which is largely developed, with its roots ranging over what I may term an extensive pasture-field, is likely to maintain its health and vigour for a much greater length of time than one that is by the force of circumstances restricted in its growth. But there are practical difficulties in the way of the general adoption of the former mode of culture. In the first place, all experience goes to prove that the vine is what may be termed a rambling rooter. If the border is not carefully made, and of such materials as to induce the formation of a numerous progeny of fine branching fibry roots, the width of any ordinary vine-border will soon be traversed by them. This takes place even when the

“restrictive system” is adopted, and it will take place with infinitely greater rapidity under the other. To meet this difficulty the roots have been walled in; but this only aggravates the evil, for the moment the roots touch the wall, they descend to the bottom of the border, where they are far from the genial influences of heat and air.

Another objection brought against this system is, that one vine takes much longer to furnish a house with fruit than a number do; but this can be met by planting supernumeraries, to be renewed as the permanent one advances.

A third objection is, that variety of grapes is desirable in a vinery, and that this cannot be had where only one vine is grown. Grafting or inarching will meet this objection; and it is well known that many delicate sorts of vines grow better on other than their own roots.

Thus it appears that the only serious objection to the one-vine system is the difficulty of getting a border of sufficient scope for the roots of a vine of such proportions as will fill a good-sized vinery with fruit-bearing wood; but where such can be had, I fully approve of the “extension system,” and will now proceed to give a detailed account of one of the best and most successful examples of it known to me, and with the origin of which I had some connection.

In the year 1838 I became acquainted with the late Mr Peter Kay of Finchley, near London, and up to the date of his melancholy death I continued to discuss with him, verbally and by letter, every question that bore on the culture of the vine. He always maintained the great importance of what he called “carrying a large amount of foliage on the vine” as the only sure way of keeping up its stamina, and acted on this himself. I used to

reply, that practically it was not expedient to allow more than two leaves to grow beyond the bunch. This, with the sub-laterals stopped at one leaf, I considered sufficient, and pointed to the example of the houses at Oakhill, near Barnet, then and for twenty years so ably managed by Mr Davis, who produced splendid crops of grapes, ripe in March and April, for many years in succession from the same vines, and which he pruned to one eye, and left only one leaf beyond the bunch. I thought the system I adopted, of leaving two leaves, sufficient; Mr Kay thought otherwise, and left from four to five. Carrying his ideas still farther, he said he believed that better still would be the plan of planting only one vine in a large house. This I urged him to do, and in 1855 he built a span-roofed house 89 feet long, 16 feet wide, and 9 feet 6 inches in height to the apex. In this house he planted a single black Hamburg vine in March 1856, the roots all outside, and the border prepared 89 feet in length by 15 broad. Beyond this border are the borders of other houses, giving it scope for its roots little if at all under a quarter of an acre. The vine is trained with a leading stem from the centre of the north-side wall up to the apex, and down to the south wall, for the house runs east and west. From this main stem five laterals are trained towards each end of the house—one at the apex, the others equidistant between the apex and the walls. The last time I saw it in company with Mr Kay was in 1862. I saw it again in 1864, when it had a full crop of excellent grapes, weighing, as I have since learned, 476 lb. In 1865 it bore 400 lb. of grapes; in 1866, three hundred bunches, some of them weighing 5 lb. It took seven years to furnish the house with bearing-wood. The girth of the stem where it enters the

house was, in May 1864, 14 inches. Mr Osborne, an old pupil of Mr Kay's, has ably carried out his preceptor's mode of managing this noble vine; and I trust it may long remain in robust health, a fitting monument to the memory of one who had few equals as an enthusiastic cultivator of the vine, and one who stands alone as having built a large house and planted it with a single vine to test a theory which some writers of the present day are starting as a new one.¹

Having thus placed the "extension" or one-vine system before my readers in the light in which I have long viewed it, I will, as briefly as the subject will admit of, take a review of what is said against the "restrictive" or many-vine system. The opponents of this latter system of vine-culture take their key-note from Mr Cannell, nurseryman, Woolwich, who, when gardener at Portnall Park, was so unsuccessful as a vine-cultivator that he has chronicled the death of all the vines he then had charge of, after passing through nine stages of decadence, which Mr Tillery² of Welbeck has compared to Shakespeare's seven ages of man, and described in very good verse in the 'Nottingham Guardian' of March 15, 1867. Mr Cannell's vines, we are bound to believe, died; but I am quite certain he is in error when he attributes their death to the "restrictive" or one-rod system. I know many very old vines that have been cultivated on the "restrictive system," and that have continued in perfect health for many years. At Oakhill, near London, Mr Dowding planted a number of vineries more than forty years ago.

¹ We learned from Mr Osborne, in March 1869, that the girth of the stem of this fine vine was then 17 inches, and that it was in excellent health and vigour, promising a large crop of fruit.

² Mr Tillery, who was a genial man and a good gardener, died in 1878.

I became acquainted with them in 1837, and for twenty subsequent years Mr Davis, who succeeded Mr Dowding, produced the most regular and finest crop of grapes in the kingdom from these same vines, yet they maintained their health, vigour, and fruitfulness. They were planted one vine to each rafter, and the system of pruning was the "close-cutting" one, by which only one eye was left at the base of each lateral.

There is a vine, referred to in this work, at Wrotham Park, which is eighty years old, and has all along been cultivated on the "restrictive system," for it only clothes two rafters; yet I learn from Mr Edlington, who now has charge of it, that it is in as full health and vigour as any of the younger vines, and bears equally fine fruit, and has a stem 1 foot 7 inches in girth. True, the border it grows in has been once renewed in the time. In regard to this old vine, I make the following extract from a letter from Mr Edlington. He writes: "The old Hamburg produces fruit equal to the other and younger vines in the same house. Last year they were truly magnificent, surpassing all other grapes on the place."¹

I might go on multiplying instances to prove that vines neither become unfruitful nor die off in nine years, as Mr Cannell's did, because they are not allowed to extend the area of their foliage annually, but I think such unnecessary. The fact is, that the vine is a very docile plant; and if its foliage is kept free from the attacks of insects—if over-cropping is avoided, and the wood well ripened—if the border is made of moderately good materials, and the drainage sufficient,—the vine will continue in health and vigour for fifty years under any of those systems of pruning and training that are prac-

¹ I saw this vine in May of this year, 1879, with a splendid crop on it.

tised by gardeners of intelligence, whether that be the "restrictive" and close-pruning system, or the "extension" and long-spur system.

I therefore close this chapter as I began it, by saying that there is much truth on both sides of this question.

Where it is necessary to have circumscribed borders, as is generally the case, I would plant a vine to every 6-foot run of a vinery, and grow two rods from each plant. This would give such vigour to the roots as would react on the branches in such a way as to yield both good bunches and berries, while at the same time a border 20 or 30 feet wide would afford them sustenance for many years.

Where there is ample scope for the roots to run unchecked and uninjured for 150 or 200 feet, then by all means adopt the one-vine or "extension" system, in-arching or grafting on to this patriarch all the varieties required.

THE DISEASES VINES ARE SUBJECT TO.

In the front rank of these stands the disease known to gardeners as "shanking." This great enemy to grape-growing makes its appearance just as the grapes are changing from their acid to their saccharine state, and it arrests the transformation at once, and the berry remains perfectly acid, and becomes shrivelled in a short time. All that the eye can detect in the case is, the decay of the little stem or shank of the berry; and what appears strange, it more frequently attacks grapes that are not forced early than those that are. Many able physiologists have attempted to explain its cause and cure, though as yet with but little success; and it is with diffidence

that I enter on a path that has been trod by such men. I will attempt to point out, first, what I think its principal cause—the destruction of the young roots during the winter; I say principal, because I consider that there may be several concurrent causes aiding the chief one, such as over-cropping, destruction of the foliage by red-spider or any other agency; and, in the second place, to point out what I think the most likely remedy.

I will describe the circumstances under which shanking is most generally met with. The most frequent of these is when the roots of the vines have descended into a cold, wet subsoil; but it is also met with where the roots are not down in the subsoil, but where they are growing vigorously, towards autumn especially, in a rich and what many would term a well-made border, where they receive plenty of liquid manure, where the foliage in the house is fine, the wood strong, and the young roots, if sought for, will be found pushing along in the rich earth in September, like the points of a goose-quill. I have known the appearances I have now described to be all present where the border was paved under the roots with stone pavement, yet there was scarcely a bunch of grapes in the house that had a dozen unshanked berries on it. I must now describe what I consider took place in the case on hand. The vines made great, strong, young roots in this rich soil late in autumn; they were not short, branching, fibry roots, but soft, like the roots of some bulb; and by the time the action of the leaves had ceased, these roots were anything but ripe, and they all perished, during the winter rains, back to the old stem-roots from which they sprang. The vines, nevertheless, have a given amount of stored-up sap in them, though they have lost their active roots, and they are

pruned and started, say, the following February. While this stored-up sap lasts they grow vigorously enough, but a period arrives when it is exhausted ; and the new comes but slowly, for the old roots that remain are just beginning, through the action of the foliage, to start into life a fresh set of young ones that are able as yet to supply but little. This takes place when the berry is passing through the stoning period of its existence—always a crisis with fruit of any kind ; and the consequence is, a thorough failure of the crop from shanking, either resulting directly from want of proper nourishment at this important period, or from some other hidden cause which springs from this want. The crop of fruit is lost as thus described, but the vines *seem* in good health, and they make strong roots towards autumn, again to share the fate of their predecessors ; and so the round goes on.

The proper remedy for such a state of things—and I have never known it fail—if over-cropping is avoided in the future, and the necessary care bestowed on the vines in every other respect—is to raise the roots and remove the rich damp soil of the border, replacing it with the compost already recommended in this treatise, and relaying the roots carefully in it. Let me add that, if the locality is a wet one, I would double the amount of burned clay and lime-rubbish in making up the compost. The class of roots that will be formed in this relatively poorer border will differ widely from those formed in the richer one. They will be much more numerous, smaller, and woody, branching in every direction, permeating its whole mass. They will ripen before the autumn rain sets in, and in such dry, open, and light soil will survive the winter, and be ready for action early the following

season. If it be objected that such a compost is too poor to produce heavy crops of grapes, I reply that it is easy, during the growing season, to give one or two good waterings with liquid manure. What is wanted is a host of healthy, hungry mouths. It is easy to feed them when they exist, but when they are dead and gone no feeding can avail; for be it remarked, that if even the points of the young roots or spongelets are decayed, absorption of sap cannot take place to any extent till they are restored; and this, in a rich, cold, damp border, is not an early process with a vine. On this subject Dr Lindley remarks: "It is not by the coarse old woody roots that the absorption of food is most energetically carried on, but by the youngest parts, and especially by the spongioles."

I have thus described what I think the primary cause of shanking in grapes—namely, the destruction of the young roots in winter. I will now assign what I consider the reason why early-forced grapes are less subject to it than late. Early-forced vines have their roots formed earlier in the season than late ones. The "rest" of the plant and the ripening of the roots are thus more likely to be complete before the cold rains of winter set in; and even in a rich border, more of the young roots survive than in the case of those of later-started vines; though, under all circumstances as to time of forcing, the rich heavy border is very unsafe for supplying constant crops of good grapes.

RED-SPIDER.

This small insect is perhaps the greatest pest the vine-grower has to contend with; and as prevention is

better than cure, the first step to be taken is to wash every part of the vinery, the wood and glass, with a brush, and warm water well dashed into every crevice, and the walls with a lime-wash made from hot shell-lime, with a little sulphur stirred into it. Let all loose bark be removed from the vines after they are pruned, scrub them well with soap and water and a brush, and give them a painting over with the mixture already recommended; let the soil of the border inside the house be slightly forked, and give it a watering with water in which a little sulphur (say one ounce to two gallons) has been stirred, which will kill any insects or larvæ that may have fallen on the soil. This done, and the vines kept in proper health, spider ought not to make its appearance till the grapes are stoning; but watch for it constantly—do no wait till the leaves are becoming red from its effects. It will first show itself at the hottest part of the house; and the moment it is seen, have the pipes sprinkled with dry sulphur, having previously moistened them to make it stick on. Repeat this sprinkling of the pipes once a-week, and it will arrest the progress of this most troublesome of insects. Some recommend constant syringing as a preventive; but I have often observed that this cure was as bad as the disease, as far as the appearance of the grapes was concerned. I am therefore averse to syringing vines with water while the grapes are on them, unless it can be had free from lime, chalk, or other matter in suspension, which forms a crust of lime or chalk, as the case may be, on the berries, and disfigures them very much. In the case of vines in the first year of their growth, the syringe may be used with perfect safety, as there is no fruit to injure. Steaming, and an atmosphere

highly charged with moisture, have also been recommended ; but, independently of the bad effects of such a climate on the vine itself, I do not believe moisture checks the progress of red-spider, for I have seen it thrive perfectly on plants standing all summer in an aquatic tank, in a steaming atmosphere. Sulphur is a real specific for the pest, where it can be effectually applied from the surface of hot pipes. Injury to the fruit may be apprehended from sulphur put on the flow-pipes if they are made very hot. The constant evaporation of water, with guano stirred into it, from saucers or troughs placed on the hot pipes, has been found to act as a preventive against the attacks of red-spider, and at the same time to conduce to the health of any class of plants, whether grown for fruit or flower. It charges the atmosphere of the house with ammonia to the extent of making it something like that of a dung-frame, in which it is well known that insects do not thrive, and all plants requiring heat do. Other sources of ammonia will suggest themselves to the reader. The atmosphere of the house should, however, never be charged with it to the extent of affecting the eyes of a person, as that of an ill-kept stable does in hot weather, for fear of injury to the plants as well as to insects. Lengthened experience has satisfied me that red-spider is much more troublesome where the soil is light and porous, and the rainfall small, than where the soil is strong loam and the climate moist ; and as a preventive wherever the former conditions exist, I advise that the borders outside be mulched during summer with 6 inches in depth of manure, and if the summer is anything like that of 1868, give it several good soakings of water. This will keep the foliage of the vines full of sap ; and,

for some reason known to itself, red-spider prefers foliage that is suffering for lack of moisture to that which is crisp and full of it.

RUST ON GRAPES.

This is a disease that makes its appearance on the berries in a few days after they are set; every grape-grower is too familiar with it to make it necessary I should describe it. Some have said it is caused by handling the berries while thinning them; others, by being rubbed with the hair of the thinner's head; others, again, by cold currents of air. I am not prepared to say but that any or all of these causes will produce rust; but I am certain that the most fertile source of it is the application of sulphur to the pipes or flue about the time the grapes come into bloom. I was led to suspect this some time ago by observing that in houses where the foliage was affected with a sort of green warty excrescence on the back of the leaf—of which more hereafter—the very day sulphur was applied to the pipes, these green warts, if I may term them such, became black, and killed to all appearance. Here, then, was a case where the sulphur was affecting organised vegetable matter. This led me to suspect it might be the cause of rust, in as far as it was likely to be able to affect the young and tender skin of the embryo grape as that of the parts of the leaves referred to; and I was confirmed in this belief by the following circumstances: In a house of vines, where we also grew French beans and strawberries, red-spider was very troublesome, and before the grapes came into bloom I had the pipes painted with sulphur. This house was the only one on the place where

sulphur was used till after the grapes were set some time, and the only one where they had rust on them. This year (1862) I applied no sulphur to the pipes till the grapes were stoning, and they are perfectly free from rust; and as they have been treated in every other respect exactly the same as formerly, I have satisfied my own mind that sulphur applied to hot pipes, in a house where vines are in bloom, is sure to cause rust on the berries, especially in the case of such tender-skinned grapes as black Hamburgs.¹

MILDEW ON THE VINE.

Mildew, when it attacks the vine, is a most insidious and destructive disease. Its ravages in the vineyards of the Continent have been of the most serious character, involving the ruin of thousands; and in our own country, some twenty-five years ago, hundreds of vineries had their crops destroyed by it. In Middlesex, where I then lived, this disease was almost universal, but I never had it except on one vine, and this one grew in the cold end of a fig-house, where it was shaded a good deal by trees. This house had but little heat applied to it by artificial means, and was the only one of seven houses in which we had vines, where the treatment and the situation of the house were such as to favour, according to my views, the development of the spores of the vine mildew. The house was in a damp, shady situation. The vines were never forced, but allowed to come on with the heat of the sun; and the season when the disease made its appearance was cold and wet. As soon

¹ Further experience confirms the opinion expressed in this chapter about sulphur being the fertile source of rust.

as I observed it, I sprinkled sulphur on the flue, and began firing it, keeping a current of air as dry as possible in the house. I watched the stems and thread-like links of the parasite on the leaves and berries with a glass, and I found that the current of dry air and fumes of the sulphur caused them to shrivel up and die. The disease made no further progress, and I believe it will never attack vines that are grown in a proper climate. As to heat, moisture, and ventilation, many treat their vines so as to predispose them to it, or rather they bring about such a climate as the mildew will grow in. It is not uncommon for individuals to have some favourite day in June, perhaps, when they give up firing their vinery. They still continue the usual sprinkling with water, and shut up the house with a stagnant atmosphere, loaded with moisture; and it often happens that cold nights reduce the temperature of the vinery so low that the vital energy of the vines is depressed, predisposing them to disease, while they are in a climate well adapted to the growth of fungi of any sort. To a careful attention to the keeping up the proper degree of heat during the whole forcing season, not too much moisture, and a constant circulation of fresh air, I attribute the exemption from vine mildew I have experienced when vineries not five hundred yards off had their crops ruined by it. It has been supposed by some that the mildew merely makes its appearance as the consequence of a diseased condition of the tissues of the vine; but this I hold to be a mistake. The spores of the parasite in question may exist in myriads on every inch of the vine's surface and do it no harm, unless the climate of the vinery is made to suit their development, when they spring into life as if by magic, and arrest the growth of all they attack. In a

hot and rather dry climate they never can do this, and in such the vine may be considered safe from their effects.

WARTS ON THE BACK OF THE LEAF.

This is a sort of conglomerate of little green warts that form on the lower surface of the leaf, as if the result of an extravasation of sap through its epidermis or skin. Some writers say this is not a disease. If it is not such, strictly speaking, it is at least organised matter in the wrong place; and I am confident it seriously impedes the important functions of perspiration, digestion, and respiration; so that if not in itself a disease, it leads to functional derangement, which is nearly the same thing. As has been remarked while treating of the effects of sulphur, these green warts are more easily affected by the particles thereof floating in the atmosphere of the vinery than any other portion of the vine, except the embryo berries.

I can undertake to produce or prevent this disease—shall I call it?—at any time betwixt the first expansion of the foliage and the stoning of the fruit. A close, warm atmosphere, saturated with moisture, will produce it; whereas a free circulation of air, moderately charged with moisture, will prevent its appearance. I have seen instances where the leaves were so affected by it that they all cupped themselves up round the edges, the fruit did not swell to much more than half its natural size, and the general progress of the vine was retarded.

AIR-ROOTS ON THE VINE.

Though this cannot be called a disease, it is a state of things that is not desirable. It proceeds from one of two causes, or both combined. Either the atmosphere is kept too moist, or the border is too cold, and probably wet, for the natural roots to make progress in at the time; and to supply the demands of a large expanse of foliage these roots are thrown out.

If the natural roots were in a border that, in texture, temperature, and moisture, was congenial to their nature, and the atmosphere of the vinery what it ought to be, there would be no air-roots; so that at least they are symptoms of an undesirable state of things, as I have already said.

SCALDING.

I have used the above name for a disease that certain varieties of grapes, more especially Lady Downes and the Muscats, are subject to, just as they are finishing their stoning. It attacks individual berries in the bunches, and always during hot sunny weather. The berry becomes suddenly dimpled on one side, and in a few hours has the appearance of having been dipped in boiling water, after which it rapidly decays. In this way I have seen bunches, especially of Lady Downes, reduced to skeletons. The perfect remedy for this is, to give the vinery as much air as a common greenhouse during the heat of the day, the moment the disease begins to show itself, till all tendency to it is over, a period of not more than fourteen days, after which the

house may be aired as usual for a vinery. I observed from the complaints made in the horticultural press in the summer of 1864, that this disease was very prevalent—just as I would have expected during so hot a summer, and with, in too many cases, defective means of ventilation.

STOCKS FOR TENDER VINES.

Those who have paid most attention to the subject have come to the conclusion that many of the highest flavoured of our grapes, which are at the same time the most delicate and difficult to grow with success on their own roots, will one day be grown with perfect ease when we have discovered the proper stocks for them, and that late-ripening varieties will be got to ripen earlier when grafted on earlier stocks. I have not myself proved the correctness of the latter, but have read of instances of it, and, reasoning from analogy, am prepared to believe it. Of the former I had a striking proof in the case of the Muscat Hamburg on the black Hamburg stock: on its own roots I have not grown it above 2 lb. weight; while on the Hamburg stocks I have had it 5 lb. weight, with larger berries and much better finished in every way than on its own roots. I have proved the black Barbarossa to be a most unsuitable stock for the Bowood Muscat—so much so, that the fruit never ripened at all on it; while by its side the Bowood Muscat ripened perfectly on its own roots. The importance of this experiment lay in the proof it gave that a late stock procrastinated the ripening of the variety grown on it; from which one is led to infer that an early stock, like Sweetwater or Chassels Musqué, would facilitate the ripening of late

sorts inarched on them. Of the excellence of the black Hamburg as a stock for such high-flavoured though delicate grapes as Muscat Hamburg, and the whole of the Frontignans, I have not the slightest doubt; and I have during last summer inarched these sorts and many others on it, and recommended others to do the same, feeling confident that success will be the result.

PACKING GRAPES.

There are many ways of packing grapes, though perhaps none of them perfectly successful in the preservation of the bloom where they have to be sent to a considerable distance by public conveyance. The method I practise myself is the following: I have light deal boxes made, capable of containing 10 lb. of grapes. The boxes have a division in their centres; they are thus in two compartments. I place a layer of fine paper-shavings in the box: I then wrap each bunch of grapes in a sheet of fine silver-paper and lay it on the shavings in the box, then a few shavings betwixt it and the next bunch, till the compartment, which holds four moderate-sized bunches, is filled, when all corners round the bunches are stuffed full of shavings, and a layer is laid on the top of all, so that when the lid is put on with screw-nails the bunches are subject to a sort of elastic pressure. This, without bruising them, keeps them from shifting about in the box. It is better to err on the side of packing them too firm than loose; for, tossed about as the boxes are in railway trucks and vans, if they are not firm they suffer very much. The division in the box takes off the weight of pressure one set of bunches would exercise on another.

KEEPING GRAPES AFTER THEY ARE RIPE.

This is a matter where care and attention can do much. I have kept Lady Downes seedling grapes hanging on the vine till May, in a house where we began cutting black Hamburgs in August. This house is 110 feet long, 11 feet high, and 11 feet wide, and has been referred to already as having been planted in 1858. It is a common lean-to house, built to serve the double purpose of growing figs on the back wall, a vine up each rafter and one half-way up the centre of each sash, the sashes being 5 feet wide. The ventilation is by an opening sash to the north on the top of the wall, and the front sashes open outwards in the usual way by lever and rod. The cost of this house, including boiler and two rows of 4-inch pipe along the front, was under £200; and at Christmas we had four hundred bunches of Lady Downes and West's St Peter's grapes hanging in it.

In order that grapes may keep well, it is necessary that they should be well ripened by the end of September, and not grown in a wet border, nor should the internal atmosphere of the house be kept loaded with moisture. What is required in grapes to keep well is a firm, fleshy berry, not one full of water. The bunches should have the berries well thinned out, more so than in the case of grapes that are to be used shortly after they are ripe. Long tapering bunches keep better than broad-shouldered ones, as the berries in the centre of the latter are apt to damp off and destroy the bunch before it is observed. As soon as the grapes are thoroughly ripe, the night temperature should be lowered to 50° till the leaves

fall off or ripen, when they should be removed carefully by hand from the vines. After this date the fire-heat should never exceed 45° , nor fall below 35° at night; and in damp foggy weather I keep the house carefully shut up for nights and days at a time. To give air during a damp foggy day is to fill the house with the very evil you wish to avoid—damp air. The surface of the internal border is allowed to get perfectly dry and to remain so all winter, care being taken that as little sweeping or raking takes place as possible, for by this means dust is raised, which settles on the bunches. Half the roots are in the outside border, and had no covering at all.

Towards the close of February I cut about fifty bunches of the Lady Downes, detaching the branch on which the bunch grew, as when pruning the vine. I then sharpened the ends of the branches, and run some four or five of them with a bunch on each into the side of a mangold-wurzel laid on the shelf of the fruit-room, allowing the bunches to hang over the side of the shelf. In this way the grapes kept perfectly fresh till April. I left some fifteen bunches on one vine for experimenting upon, two of which are still hanging at this date, May 2. About the 15th of April the sap began to rise in the vines, and some of the berries that were a little shrivelled suddenly got plump, while others that had shown no signs of shrivelling burst their skins, and the sap of the vine that had forced itself into them began to drip from them. It was tinged with colouring matter out of the berry, and had the taste of the berry. To stop this bursting of the berries, I made an incision in the lateral on which the bunch hung, betwixt it and the parent stem of the vine, in two places, half through, at opposite sides of the lateral: This drew off the sap, and no more

berries burst. The vines have now young growths on them 9 inches long, and are appropriating all the sap, and the bleeding has ceased from the incisions. In February I had all the eyes picked out of the laterals except the one at the base of each. These are showing fruit like others that were pruned in the usual way, except the three I bled: they are much weaker than the others. From this experiment it may be reasonably inferred that it is not judicious to keep grapes hanging on the vines after the sap begins to rise. It, however, proves that it is possible to cut old grapes in May, and considering that new can be cut in January, gives an overlap of four months in the supply of grapes.

AMATEUR'S VINERY CALENDAR.

If ripe grapes are desired, say, on the 20th of July, it will be necessary to start the vines on the 1st of March, they having been pruned and dressed in the autumn, as already directed.

If the border is in a proper condition, and the vines vigorous, begin with a night temperature of 50° , and allow it to rise to 65° with sun-heat during the day. Keep the atmosphere of the house as moist as possible, and syringe the vines several times daily with tepid water. As soon as the buds burst, raise the night temperature to 55° , and let there be a corresponding rise from sun-heat throughout their progress. When the buds are half an inch long, rub off all but the strongest one at each eye, and discontinue the syringing. As soon as the embryo fruit-buds can be seen in the points of the young shoots, raise the night temperature to 60° ; and if they have the appearance of a sort of compro-

mise betwixt a fruit-bud and a tendril, discontinue the supply of moisture to the atmosphere, and raise the temperature to 65°. This is a very critical stage with vines whose wood has not been well ripened, and that are, in consequence, prone to show tendrils instead of bunches. The only chance of saving the crop is to give a high dry temperature. On the other hand, when the vines have been well ripened the previous year, the embryo bunches show themselves with the flower-buds well individualised, and there is little danger of their running off into claspers. This being the case, a moderate degree of moisture should be kept up from the steaming-tray. As soon as the shoots have run out, so that their points can be pinched off at two joints beyond the bunch, let it be done with care, so as not to injure the young leaves that are left. I recommend that, as soon as the best-shaped bunches can be distinguished, all but one on a shoot should be taken off at once. This can generally be done when the shoots are stopped or pinched. When the young shoots have become sufficiently woody to stand bending down to the wires, get them tied down carefully. Small lateral growths will start at each joint of the young shoots; these should be pinched, so as to leave one joint. Some leave no joint, but pinch off close. I have known this cause the proper eyes of the shoot to start, which is an evil. By the time the bunches are in bloom let the night-heat be 70°, and keep the atmosphere dry.

As soon as the berries are set, cut off all the bunches except those required for the crop at once. Any other course is a waste of sap, which will all be needed. It is difficult to give directions as to the number of bunches that should be left on a vine, so much depends on the

vigour of the plant and the size of the bunches. As a rule, I consider 1 lb. of grapes to every two superficial feet of glass a fair crop. Throughout the entire period of forcing, a constant circulation of air should be kept up, as directed in the body of this treatise. In May and June, if the weather is hot and dry, little fire-heat will be required, and consequently little evaporation will take place from the steaming apparatus. In such a case the paths and border may be sprinkled slightly with water; but avoid the stewing system by all means. As soon as the grapes are thoroughly ripe, the house should be kept as cool as it generally can be in July. In the case of Muscat grapes, I would let the temperature at all stages be 5° higher than that I have recommended. I have shut up a Muscat house with a sun temperature of 100° ; but 95° is safer, and 90° in the case of all other sorts.

EXPERIMENTS WITH VINES.

The first of these that I shall describe is that of a very large house of vines at Wrotham Park, Middlesex.

When I entered on the management of these gardens, in the autumn of 1837, I found all the vineries in a very unsatisfactory state, and it was determined that the vines and borders of three of them should be renewed at once; but the large house in question was not one of those—it was 65 feet long, 22 feet wide, 7 feet high in front, and the back wall 16 feet high. There was a row of strong cast-iron pillars running along the centre of it to support the rafters, and against these the vines were planted, twisting round them like enormous snakes. My employers were loath to have these old vines destroyed, and wished me to make an effort to renovate them if

possible. I made a careful examination of the state and position of their roots, and found that none of them were within a foot of the surface of the soil. It was the custom to keep all the bedding-plants standing on the floor of this house, and the constant watering and treading had made the whole surface, which had not been broken up for years, as hard as asphalt. This I had picked up, and removed from the house, to the depth of one foot ; I then got hold of the leading roots, and traced them as far as possible. When they could be pursued no further without going a great depth, I cut them, and coiled them round the pillars that supported the stems, till in this way I had raised some eight or ten of the roots of each vine, not one of which, as far as I traced them, had any live rootlets on them. I had mats put round these bundles of roots, and kept them damp for the time being. I removed six old peach-trees that grew as standards in the house, the vines being confined to the rafters. I took out a large pit where each of these stood, and in doing so cut many of the roots of the vines. I then filled the pits for the peach-trees with the best turfy loam I could get, and planted them, and laid 6 inches of the soil I had prepared for the new vine-borders all over the surface of the border of this house, with a considerable extra allowance of good rotten dung. I then laid out all the roots on this bed of new soil, making a regular set of incisions with the knife right and left, about 9 inches apart, along their whole length, covering them over with 6 inches of the same compost, and giving them a good watering with warm water. This was done in March, just as their buds were beginning to swell. They broke as weak as straws, and looked very miserable till about the end of July, when they showed some signs of making second growths

of a more vigorous character than the first. Shortly after this time I dug down to several of the roots I had made the incisions in, and found that, from the lip of each wound nearest the parent stem, a great number of young roots, like porcupine-quills, had started off into the new soil. This was in the summer of 1838, and in 1839 they broke comparatively strong, showing a fair crop of fruit, which they brought to perfect maturity. In 1840, and for seven or eight years afterwards, they bore first-rate crops of excellent grapes, colouring well. They were black Hamburgs. About 1848, however, they began to indicate that their vigour was on the wane; and as the house had to undergo extensive repairs, I removed them all to make way for a new border and young vines, except one at the west end of the house, which I kept, partly as a memento, and partly to experiment upon. During the process of removing the old border, I had the entire soil and roots removed from the one in question to within 6 feet of its stem. I then removed the soil from the bare arms—for roots they could scarcely be termed—to within 3 feet all round; and after making incisions in them as before, I laid them, radiating from the centre, in the new soil of the border made up for the young vines; and though the vine looked sickly for a time, and the leaves flagged during sunshine, it soon recovered, and, for the subsequent six years I had the management of it, bore fine crops of grapes. Of this vinery, and of the particular old vine in question, the late Mr. Robert Fish thus wrote in 'The Cottage Gardener and Country Gentleman's Companion,' in the number for July 14, 1857, while describing the gardens at Wrotham Park: "We observed that the forcing-houses were showing well for fruit; that the huge vinery in the centre of the range

—where the vines are planted in the centre of the house, the stems supported by iron pillars till they reach near the glass, and then branch to the back and front—was in great luxuriance, though the size of the stems spoke of the vines having seen many summers” (they were then, with the exception of that to be referred to, only nine years old), “and one of these stems seemed to be contending for the mastery with the iron column, clasping it so firmly, as ultimately, I fear, to suffer from the embrace.” This latter was my old friend, whose roots I cut in so severely; and when I saw this same house in 1860, this octogenarian—for such he must be—was in as great vigour as the comparatively young vines by his side.¹

Another, to some extent experimental, process, by which I renewed the border and replanted a house with Muscats at Wrotham Park, may be interesting, and probably useful, to some of my readers. This house was what had been a pine-stove; and up each rafter a very old Hamburg vine was trained, pines being grown in a pit underneath them. For special reasons it was determined to grow fewer pines, so that this house would not in future require to be occupied with them; and it was determined to make a new border, which had to be entirely outside the house, and plant the house with Muscats, after cutting a crop of grapes off the Hamburgs, in 1847. With a view to this I got as many round flat hampers as there were rafters in the house to be planted, and set them on some boards on the floor of the large vinery previously described. In the bottoms of the hampers I laid thin turfs, with the grass sides down. On this I placed nice, sharp, but not very rich soil, and in March shook out of their pots the required

¹ This vine at the present date, 1879, is as vigorous and fruitful as ever.

number of year-old Muscat vines, cut back to about ten eyes some months previously, placed the stem near one side of the hamper, and spread out the roots like the fingers of an extended hand, covering up with the same sort of soil, and finishing with a good watering, placing a hamper against each of the pillars and training the young rods up the pillars. As this large house was only kept a little closer than a greenhouse, the vines made fine short-jointed canes. By the latter end of June we had finished cutting the grapes on the black Hamburgs that the vines in the hampers were destined to replace, when I removed them, and on the 1st of July had the border made up to the extent of 9 feet in width along the front of the house. Seats were made in the soil of the border for the hampers, whose bottoms were rotten by this time. The planks on which they were set enabled us, however, to move them in safety. The young canes were introduced through the front wall as the old ones had been. About three joints of the previous year's wood were laid in the soil, after having an incision made in it below each joint. (The danger to be apprehended from the attacks of fungi would now lead me to omit the incisions, especially where bottom-heat is to be applied.) The hampers were then cut away and removed, leaving the great round flat ball full of fine young roots, to be covered over with 4 inches of soil. The young canes were from 12 to 14 feet long, two from each plant, when planted. They did not receive the slightest check to their growth, but made splendid canes to the top of the house, and ripened thoroughly in the autumn. They would have yielded a good crop of grapes half-way up the house, in 1848, had they been allowed to do so. As it was, they were allowed to carry

two bunches to each rod, making four to each plant. In 1849 they bore twelve bunches on each rod, and in 1850 the heaviest crop of Muscats I ever saw, many of the bunches weighing $3\frac{1}{2}$ lb.; and up to 1860, when I saw them last, they have borne exceedingly heavy crops of fine grapes. Had I prepared a double set of vines in the same way, so as to have cropped one-half the first year, and then to have cut them out, the border and vines could have been renewed without the loss of a single crop. From this house I have more than once cut old grapes in March; on one occasion, on the 16th of that month.¹

In March 1869, I received the following replies to queries I addressed to Mr Edlington² about this Muscat house: "The roots of the Muscats have traversed the border 15 feet wide, passed underneath the walk at a depth of 2 feet, and are there as thick as walking-sticks; and they extend 60 feet into the asparagus brake beyond the walk, in which they seem to luxuriate amazingly. The vines are in fine health, and every year they bear enormous crops without a shanked berry." Mr Edlington further stated that he crops the vine-border proper with bedding-plants half-way across it, and that he believes it does the vines no harm. My own opinion is, that the case might be otherwise were the feeding roots of the vines confined to the original border, instead of enjoying a roving commission in the asparagus quarter. My *beau-idéal* of a vine-border would be one tacked on to a well-made asparagus plantation, where top-dressing was an annual event, and sufficient sun, air, and moisture could be obtained, yet the vine-roots never disturbed by digging or trenching; and no doubt this is

¹ This house had a fine crop on the old vines when I saw it in May 1879.

² Mr Edlington, an excellent gardener, has been dead some years.

one reason for the great and long-continued fruitfulness of the vines in question.

The only other case of this character which I shall describe, as founded on my own experience, was the raising of the roots of a house of vines in the gardens at Dalkeith in June 1855. It was evident that the roots of the vines in question had grown down to the subsoil, and I determined to raise them and lay them in new soil. On the 8th of June, after covering the glass of the house with a tarpaulin, I had a trench cut down right along the border, within 12 feet of the front of the house, and then cleared away all the old soil, and raised the roots close up to the front wall. We thus had the whole of the roots disengaged from the soil, as there was then no border inside the house. I had them laid as fast as possible into the new soil, and well watered. Their foliage all flagged and hung down; but I kept the house close, moist, and warm, and excluded all the direct rays of the sun effectually. The berries in the bunches were the size of peas, and for a few days they were quite wrinkled in their skins. At the end of a week the leaves began to turn up a little. I then took off the tarpaulin and put on a lighter shading of tiffany, and in the course of another week I removed this also and put on hexagon netting. In a month from the date of the operation they were perfectly recovered, and growing fast. They ripened 30 lb. of good grapes the same year, and in 1856 bore a splendid crop of fruit, and continued to do so for three subsequent years. The vines were, however, old, and had been pruned on the long-spur system, which rendered them unsightly. All our other vineries were planted with young vines in 1856, and in 1860 were in full bearing. Under these circumstances I was induced

to make arrangements for doing away with the old vines in question, but before doing so, determined to have one more crop off them as early as possible in 1861, and replant the house the same year. To hasten this, I removed a pine-pit no longer required in the house, the removal of the front wall of which gave access to the roots of the vines in the outside border through the arches of the front wall of the house. I then filled the interior of the house, previously occupied by the pit, with hot fermenting dung and leaves. This material was placed in close contact with the roots of the vines through the arches, and acted as a hot lining to the entire border. The outside surface of the border was covered with dry leaves and thatched. The house was started in this way on the 1st of September, and on the 1st of January 1861 we cut the first dish of grapes, — exactly three months earlier than we cut from the same house the year before, though started at the same time, and treated in the same manner, with the exception of the hot lining to the roots. Seeing that the success of this experiment was so satisfactory, and finding, on examination, that a host of fine roots had established themselves in the lining as it cooled, I made up my mind to give them another trial, and the following summer I pruned them in July. In the end of August I put a quantity of hot fermenting dung and leaves on the top of the previous year's lining, so to speak; and we cut excellent grapes on the 1st of January 1862. The crop was nearly double that of the previous year; and in March the wood was perfectly ripe, and much stronger than I ever saw it in this house before. I need scarcely add that the sentence at one time recorded against them for their unsightliness has been revoked.

Some may consider that I have been tediously particular in my efforts to explain this case ; but if so, they must excuse me on account of my anxiety clearly to establish the importance of bottom-heat for early-forced vines ; and from my own experience in the case of these vines, as well as from theoretical reasoning, I have come to the conclusion that it is less destructive to the constitution of vines to begin forcing them in August than in October. My opinion on this subject has been endorsed by Dr Lindley, whose great eminence as a vegetable physiologist is universally recognised. In his remarks in a leading article in 'The Gardeners' Chronicle' for February 22, 1862, on an article on this subject which I communicated to the 'Florist and Pomologist' of that month, he says : "It is quite evident, as Mr Thomson points out, that the natural chemical advantages are all on the side of the earlier-forced vines. When started in August, they have before them three months of comparatively fine weather, which is of immense importance to them, and suffices for all the more critical periods of their development. When started in October to be ripe in March, the entire period of growth belongs to the most dreary and unpropitious part of the whole year ; so that it would seem resting the vines in the hot dry months of summer—dryness being at that period the maturing agent—and renewing the growth in August, so as to snatch as much as possible of the fine weather of autumn for all the earlier stages of growth, turns out, in practice as it does in theory, to be the proper course for producing new ripe grapes on New-Year's Day, and this with better results than would be obtained a couple of months later."

VINE-ROOTS.

The roots of vines, like those of most other trees, have a tendency to descend into the earth, and when they reach certain subsoils they become unhealthy—besides which, they are then far from the genial influences of sun and air. To prevent this, remove a few inches of the surface of the border every summer during dry weather, which will most probably expose some of the roots,—at any rate, descend till they are reached ; then on, under, and amongst these young roots lay a few inches of nice fresh loam, horse-droppings, and old lime-rubbish in equal parts, with a few handfuls of ground bones. Into this mixture the vines will send a mass of fine feeding fibry roots, that with similar annual attention may be kept there, where they should be mulched as already directed, and during very hot dry weather fed with liquid manure, either from the farmyard or cesspool. When neither of these is available, mix guano at the rate of one ounce to the gallon of water. If this process is persevered in, it reduces the importance of concreting the bottoms of vine-borders, as the vines seldom suffer from any roots formed at too great a depth. An amateur close to this place has for many years grown splendid crops of grapes, chiefly Muscats. The vines are planted in an outside border, only 6 feet of which was made soil, and the roots are all right through it into the general soil of his garden, which is poor, shallow, and gravelly ; but he annually covers more than 30 feet in width of the soil on each side of his span-roofed house with 6 inches of nearly solid cow-manure, which during the year washes into the soil, and is, when examined, a com-

plete mass of fine vine-roots, and is not disturbed except by the hoe, to kill weeds, the sharp hungry soil preventing all danger from over-feeding by such means. To this mulching, and occasional waterings during the scorching summer of 1868, when every tree and bush, as well as weed, in his garden was covered with red-spider, he attributes the immunity from that pest which his vines enjoyed. From this vinery I conceive a sound lesson in grape-growing may be learnt, hence my reason for referring to it.

OPEN-AIR CULTURE.

In the latitude of Britain the grape vine can only be grown in the open air with very partial success, even in the most favoured of the southern counties, and then it must be trained against a wall with a south aspect. The soil in which the vine should be planted for open-air culture, should not be so rich as that used for it under glass, and should consist of three-fourths light sandy loam, the other fourth to be made up of old lime-rubbish, brickbats, and burned clay, with a small proportion of broken bones. In this compost it will not make such strong canes as in a richer one, but they will ripen better, and have more prominent fruit-buds than the product of rich soil. The young wood should be nailed close up to the wall as it advances, so as to get the benefit during the night of the heat the wall has absorbed from the sun during the day. As to pruning and training, the same course should be pursued as what I have recommended for the vine under glass. During the cold nights of spring, early summer, and autumn, great benefit will result from covering the soil along the

bottom of the wall where the roots of the vines are, with fern, straw, or any such litter, as soon as the sun ceases to shine on it; to be uncovered every morning when the sun shines on it again. In this way the heat derived from the sun is retained in the soil, instead of passing off by radiation, as it soon does, especially in clear cold nights. With a wooden rake the operation of covering and uncovering is soon performed, and might with great advantage be applied to other wall fruit-trees as well as to the vine.

Various methods of protecting the young buds of the vines from spring frosts, such as covering with oiled calico, old fishing-nets, &c., will suggest themselves to all concerned. A considerable width of projecting coping is of much importance, in as far as, besides sheltering from frost, it throws the wet clear of the foliage and fruit of the vine. As soon as the grapes are set the soil may receive a good watering with soap-suds or any other liquid manure, to be repeated occasionally during the summer if the season is a dry one. During autumn and winter the roots should be kept as dry as circumstances will admit of. In no case would I put a permanent mulching over the roots during summer, as it prevents the warming of the soil by the sun. A few cucumber or melon lights fixed against the wall, so as to cover the vines during autumn, will hasten the ripening of the fruit, and protect it from heavy rains. From what I have seen of the field-culture of vines for producing wine in France and Germany, I consider that, by the application of greater horticultural skill, the crops of grapes might be very much increased; but it would be difficult to break through the strong crust of prejudice that exists in favour of things as they are.

In Australia, where extensive vineyards are being planted on the Hunter River and elsewhere, though they have much to learn, they have nothing to unlearn, like their brethren on the continent of Europe. James Elliot Blake, Esq., of Tabelk Vineyard, Melbourne, informed me recently that when they extend their plantations they trench the soil, and then cut young canes from the established vines 6 feet long, and run one end of the cane 3 feet deep into the soil, and that they make very little progress for two years. If, instead of proceeding in this primitive way, they were the previous year to make a long range of trenches, sheltered round the sides by turf, over which during cold or excessively hot weather some sort of cloth could be run, they might strike plants from cuttings of two eyes by the thousand, to be transplanted by having their roots properly spread out in the soil as it is being trenched; such plants would come sooner into a bearing state, and make better permanent vines than those planted as at present. And when the great value of the produce of a single acre of vineyard is considered, no ordinary preliminary expense ought to be withheld that would add to its productiveness. A gentleman who has vineyards in the neighbourhood of Sydney told me recently, that from one acre of vines he sells £100 worth of grapes in the Sydney market annually, and of those that are not fit for market he makes twelve hundred gallons of wine that he can sell at 3s. 6d. per gallon.

As a manure for vineyards nothing will prove so permanently beneficial as broken bones. The green prunings of the vines are also useful as a manure, and should be forked or dug into the soil once a-year; but the roots of the vines should be disturbed as little as possible.

The stakes used for supporting the vines should have their points charred and dipped in pitch while hot, to a couple of inches above their ground-line ; and instead of using a stake for each vine, four could be bent so as to meet at a central point, where they could be tied to one stake.

LIST OF VINES.

1. *Black Hamburg*.—This excellent grape is so well known that comment would be superfluous.

2. *Champion Hamburg*.—This is a variety of the above with larger berries, and as fine qualities in every other respect.

3. *Frankenthal*.—This is undoubtedly a variety of the black Hamburg, though a very distinct one. The berries are perfectly round, sometimes oblate. In flavour it is rich and juicy ; and it nearly always colours jet black.

4. *Richmond Villa Hamburg*.—This is a variety of the black Hamburg, which, though distinct in foliage, is similar in other respects to it.

5. *Dutch Hamburg*.—The bunches of this grape are not so large as the other varieties of Hamburg ; but the berries grow to an enormous size. The skin is thick, and the flesh coarse. It nearly always colours jet black, with hammered skin. For mere exhibition as a “basket of grapes” this has no rival in its class. The whole of the Hamburgs are free setters, and will ripen in a cool vinery.

6. *Muscat Hamburg*.—This is the old black Muscat brought out with a new name. It is a grand grape when well grown, having every good quality that can be expected in a grape, but unfortunately it is rather capri-

cious in its growth. I have never been very successful with it. I think it does best in a heavy loam approaching to clay, on a well-drained subsoil. Mr Fowler of Castle Kennedy has produced this grape in grand condition; and I learn that in Dumfriesshire it is also very good, producing bunches 5 lb. in weight, perfect in every respect, on a heavy loam. It should be in every collection, grafted on the black Hamburg as a stock, where it will do much better than on its own roots.

7. *Lady Downes*.—This valuable grape is now so well known that little need be said of it here. It succeeds admirably in a cool vinery; but the house should be kept warm and dry when it is in bloom. It has one peculiarity that has to be guarded against, which is—that towards the close of the stoning period it scalds, and becomes suddenly black on one side, and rapid decay of the berry takes place. I have seen houses of this grape decimated in the way here described. The effectual remedy is to keep the vinery as cool as a greenhouse for three weeks after the first berry has gone wrong. I need scarcely add that this is the best keeper of all our black grapes.

8. *Gros Colman*.—Further experience of this grape proves it to be a grand late grape, of noble appearance, easily cultivated, and, if the market value is any test of worth, it surpasses all other late black grapes. It requires more heat than the Alicante or Lady Downes.

9. *Black Alicante*.—This is an easily cultivated showy grape, but the flavour is scarcely second-rate; and with such a grape available as Gros Colman, it should be planted more sparingly than it has been.

10. *Madresfield Court*.—This grape was sent out as a late-keeping grape. My own experience of it is, that it

is a free growing and bearing handsome black grape, of average flavour when just ripe, but that it will not keep even equal to the black Hamburg. A sort of decomposition takes place in the berries, that renders it utterly worthless. This is my experience of it, and it is corroborated by that of other growers.

11. *West's St Peter's*.—This is a good grape when properly grown. The vine is a free grower, and sets its fruit well under the same treatment as Lady Downes. The bunches resemble the Hamburg in shape; the berries are smaller. No house of late black grapes should be without a vine of this sort, for it is fit to use just as the Hamburgs are finished, and before Lady Downes and the other late sorts have got up their flavour.

12. *Black Barbarossa*.—On the excellent authority of Dr Hogg's 'Fruit Manual,' I am warranted in saying that the proper name of this grape is Gros Guillaume. The vine is a very strong grower, and produces very large but rather loose bunches. It sets its berries freely, and generally colours well. My own experience of this vine is, that unless grown in a high temperature it does not show fruit so freely as could be desired. The fruit keeps nearly as well as Lady Downes.

13. *Black Prince*.—This is a hardy free-growing vine, that shows and sets its fruit freely, with long tapering bunches that always colour jet black. The quality of the fruit is second-rate, and not more than one vine of it should be planted.

14. *Mrs Pince's Black Muscat*.—This has not come up to the expectations that were formed of it when it was sent out. The vine grows freely, and shows abundance of fruit, which sets irregularly, and the bunches have a ragged appearance in consequence. I am not

able to say from my own experience that it keeps well, for it shrivelled in a Lady Downes house three months before the latter grape showed a wrinkle. It is, however, a high-flavoured grape, and may yet be found useful; and I learn that it keeps better with some than it has done with me. I have seen it much improved by being grafted on black Alicante.

15. *Muscat of Alexandria*.—This grape is so well known that I need say nothing of it here. There are many varieties of it with very slight distinctions. I prefer the Tynningham variety to any of the others, as possessing every good quality belonging to this grape. It likes a good deal of heat.

16. *Bowood Muscat*.—This grape closely resembles the Muscat of Alexandria, but is not to be preferred to that variety.

17. *Cannonhall Muscat*.—This is by far the most noble looking of all the Muscats when it sets freely, but this it rarely does. The berries are very large, the bunch long and tapering, with the full Muscat flavour. It requires strong heat.

18. *Golden Champion*.—This grape has in many localities, and in the hands of good cultivators, developed a spot on one side of the berry that has rendered the fruit worthless, while others find no difficulty with it; and when perfect it has few equals for appearance and high quality. If grown on a moderately dry atmosphere the spot will not appear, and then it is a grand grape.

19. *Duchess of Buccleuch*.—This is a free growing and bearing vine, producing long tapering bunches. I question if it has any equal in point of flavour; but its berries are small, and on this account it will never be-

come a general favourite: but all who appreciate exquisite flavour should grow it.

20. *White Lady Downes*.—This grape was raised by me from the seed of the black Lady Downes. It has every characteristic of its parent except the colour and the absence of all tendency to scald. It is very late of starting into growth; but when it does start it makes up for lost time. Having a white, or rather golden-coloured, skin, its berries do not suffer so much from the effects of the sun shining on them in February and March as its black parent does, consequently it hangs later. I believe there is no other white grape that can be kept so late in the spring as this. The shape of bunch and berry is the same as the black, and the same may be said of its flavour. All who wish to have white and black grapes till the end of April should plant the Lady Downes white and black.

21. *Trebbiana*.—This is a vigorous vine, producing abundance of large bunches, which, when ripened in Muscat heat, become yellow and of average flavour; but with such grapes as Muscats, that will keep as well as it does, it never can compare.

22. *White Nice*.—This vine is a most vigorous grower, and, producing very large bunches of poor quality, should only be grown where monster bunches are wanted.

23. *Raisin de Calabre*.—This is a coarse-growing vine, producing large bunches. I cannot say much in its praise, except that it hangs well till March.

24. *Royal Muscadine*.—One of the most useful vines, especially for amateurs. It grows and fruits well in a greenhouse, is a most abundant bearer, and keeps in good condition for a considerable time after it is ripe. It cannot be said to be high-flavoured; but to my taste

it is one of the most agreeable flavours we have in grapes. Fruits well in pots.

25. *Buckland's Sweetwater*.—This is a useful summer grape. It succeeds in the same house as the black Hamburg, which it resembles in habit of growth and shape of bunch. When of a golden colour its flavour is good.

26. *Duke of Buccleuch*.—One of the handsomest and finest grapes in cultivation; succeeds well in same house as black Hamburg. It is admirably adapted for pot-culture, and should be in all collections.

27. *White Frontignan*.—There is nothing more surprising in connection with grape cultivation than the rarity with which one meets with the Frontignans, even in large establishments. Their flavour is exquisite, and on dry soil they are easily grown, especially with bottom-heat. They are also admirably adapted for pot-culture. The White Frontignan is, next to Foster's White Seedling—which it far surpasses in flavour—the most prolific grape I know for pot-culture.

28. *Grizzly Frontignan*.—This makes larger bunches and berries than the white, and is its equal in other respects.

29. *Foster's White Seedling*.—This grape is admirably adapted for pot-culture, but is rather tender-skinned, and suffers from carriage more than most other grapes.

NOTES ON CELEBRATED VINES.

I AM indebted to my friend Mr Rose,¹ gardener to her Majesty the Queen, at the Royal Gardens, Frogmore, for the following information about two famous vines—the one at Hampton Court, the other at Cumberland Lodge. Of the former, Mr Rose writes: “As far as I can learn, the vine at Hampton Court was planted in a small house in the year 1768, and the house has been enlarged from time to time till it has attained its present size. The stem of this vine at the surface of the soil is 2 feet 10 inches in circumference. At 3 feet from the surface, where it branches into three principal stems, it is 3 feet in circumference. These three leading stems run along the whole length of the house, branching off right and left, and covering with foliage an area of 1950 feet, yielding from 600 lb. to 800 lb. of grapes annually, which are ripened in the autumn. The vine is a black Hamburg, and the system of pruning is the close-spur one.

“That at Cumberland Lodge was planted about 70 years ago in a small pit by a foreman of the name of Tidy, who managed the place at that date. The vine, which is also a black Hamburg, made such rapid progress, that a house was erected over it, which has been repeatedly enlarged to its present size—the last addition having been made some fifteen years ago. At the surface of the soil this vine is 3 feet in circumference; at 2 feet from the soil it is 2 feet 10 inches; here it branches into two main stems, which at 4 feet branch each into two rods, and

¹ Mr Rose is now dead.

run the whole length of the house, branching in all directions, covering an area of 2553 feet, and producing from 600 to 1200 lb. weight of good grapes annually, ripened late in autumn. It is pruned on the close-spur system. The border is 60 feet wide, and is not cropped. The house is 138 feet long, and, like that at Hampton Court, is heated by flues; but little fire-heat is applied, as the vines are not forced.

"On receipt of your letter, I went and examined another large vine at Sillwood Park, Sunningdale, near Ascot. It was planted about fifty years ago. The house it is in is 123 feet long, with a rafter 12 feet long. The vine is planted in the centre of the house; its girth at the surface of the soil is 2 feet 4 inches. It branches into eight laterals on each side, right and left, which run the whole length of the house, occupying an area of nearly 1500 feet. It produces annually about 800 lb. of grapes. The border is the length of the house, and 29 yards wide, and has not been cropped of recent years."

From my knowledge of the habits of the vine, I am certain that the feeding roots of these celebrated vines have gone in search of food far beyond the bounds of the borders assigned to them; and I have little doubt that if they could be traced, they would be found running in drains and sewers, absorbing the fluids therein contained.

In a letter I recently received from Mr John Watson,¹ gardener to Sir Robert Peel, Bart., at his seat, the Campagna, Lammemun, near Geneva, he refers to three very large old vines in his neighbourhood. He writes: "I have ascertained from family documents that they were fine large vines a hundred years ago. The diameters of their stems near the ground is an average of 1 foot 6 inches, equal to a girth of 4 feet 6 inches. The finest of them grows on the slope of Mount Salne; the other two on the flat plain that at one time probably formed part of the Lake of Geneva. The soil they are growing in is pan chalk, which, when dug up in autumn, looks more like a turnpike-road than a vine-border; yet these vines are in great vigour, and last autumn, owing to the hot summer,

¹ I regret to say that Mr Watson is now dead.

yielded more wine, and of higher quality, than usual. The Lake of Geneva is forty miles long: on both sides it is planted with vines; and during the autumn hundreds of invalids come from all parts of the world to undergo what is termed the 'Grape cure' here. They begin by eating $\frac{1}{2}$ lb. of grapes a-day, and increase the quantity till it reaches 13 lb., when they as gradually diminish it. By this means I have known many remarkable cures effected, even of cancer, which had baffled the best medical skill."

There is a famous old Muscat vine at Harewood, near Leeds. Mr Fowler, in reply to questions I addressed to him about it, writes: "It was planted in the year 1783; the girth of the stem 1 foot from the ground is 20 inches. It branches into two leaders, each of which is 17 inches in girth. In October 1857, I lifted its roots and laid them in fresh soil, the ripe grapes still hanging on it. I found the soil it was growing in in a very bad state, and without drainage. I covered the roots carefully with mats; I gave the border plenty of drainage underneath, and placed turf fresh from the field with the grass side downwards over the brickbats and tiles used for this purpose. The soil of which I made the border was composed of fresh turf, chopped up and mixed with a fair proportion of charcoal and ground bones. For a week the leaves drooped very much, after which they recovered, and the vine made some fresh growths before its leaves dropped. The soil being fresh turf, it heated up to about 70°, and thus facilitated its recovery and the formation of fresh roots. I covered the border with glazed sashes, which threw off the autumn rains, and prevented the destruction of the recently-formed roots during the winter. In the spring it started very weak, but gradually gained strength during the season, since which date it has yielded an average of 400 bunches yearly, of about 1 lb. weight each. The system of pruning adopted for this vine is what is termed the long-spur—*i.e.*, I leave from three to four eyes of the young wood annually. Last year (1868) the wood of the old vine was as strong as that of our young vines, and I have no doubt it will improve for years to come. The grapes colour well, hang on the vine till March, and are of first-rate flavour."

The oldest vines in Scotland are, in all probability, those in the garden of David Anderson, Esq. of Moredun, near Edinburgh. They are about a hundred years of age. At one time they must have been grown as single rods over pines, as there is still a large pine-pit in the house. They are planted in an outside border, and their roots have gone out about 130 feet, passing under a garden-wall in their progress. They are in good health and vigour still.

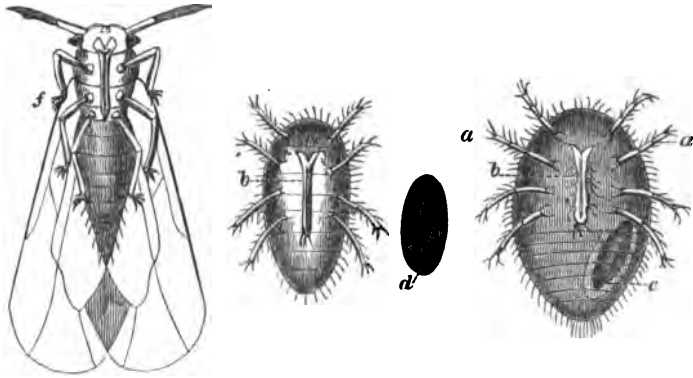
I learn from Mr Osborne that the Finchley vine referred to in the body of this work is progressing as well as can be desired, bearing immense crops of fine grapes, and that the stem is now 17 inches in girth. For its age this is perhaps the most extraordinary vine in the country, seeing it is only fifteen years since it was struck from an eye.

There is another famous black Hamburg vine growing in the Scottish Highlands in Kinnell, near the confluence of Loch Tay and the Dochart. This place was once the seat of "The M'Nabs," but is now the property of the Marquess of Breadalbane. I am indebted to Mr William Gorrie, landscape-gardener, Edinburgh, for the following particulars about this vine, which, he informs me, were derived from his own observation, and from Mr Murray, late gardener at Taymouth Castle, who once had the charge of it. It was planted in 1832 by Mr Robert Gardener—who was then gardener at the place—in a small vinery. It now occupies a house 89 feet by $23\frac{1}{4}$ feet, covering with its wood and foliage an area of 229 superficial yards. Its stem is 16 inches in girth, and rises 6 feet before it branches off. It produces 600 bunches of grapes annually, and of excellent quality, never showing a shanked berry. Mr Murray attributes its great vigour to its roots having got into an asparagus plantation, where the soil was made up artificially to a depth of 4 feet. Mr John Christie, the present gardener at Kinnell, took leading prizes at some of the Perthshire horticultural exhibitions last year with grapes cut from his vine.

THE PHYLLOXERA VASTATRIX.

THIS most formidable of all the diseases that afflict the vine having made its way to both Britain and Ireland, I have thought it as well to insert here a description of the insect from the pages of 'The Gardener,' for which periodical it was translated from the French language in 1869. In two instances where it has made its appearance in force, it has been extirpated by taking up the vine-roots and thoroughly scrubbing them with soap and water and a hard brush, and removing all the soil of the borders. At Powerscourt, in Ireland, I recently saw four vineries in which the vines were in excellent health and vigour, bearing fine crops of grapes, that two years ago were attacked by the *Phylloxera vastatrix*; and to Mr Dun, who was gardener there at the time, and is now my successor at Dalkeith, is due the credit of having, by the means named, got rid of the pest. The other case was in the neighbourhood of Tunbridge Wells; and I have reason to believe that it exists in several other gardens in the country. It must have been introduced from the Continent, either on vine cuttings or plants, or perhaps amongst raisins or other packages. Be that as it may, it is in Britain, and it would be well if all who have it would at once make an effort to "stamp it out," by the destruction of their vines, and the charring of the earth of their borders; for, after all, the labour of cleaning affected vines is so great, that it would be more economical to plant new ones in new borders, after washing and painting all woodwork, and lime-whiting all stonework.

"The following account of a new enemy to the vine, translated from a periodical published at Ghent (the 'Flore,' edited by Louis van Houtte), may not be unacceptable to the readers of 'The Gardener.'



Phylloxera vastatrix (J. E. Planchon).—Female specimens and their eggs. *a* and *a*, antennæ; *b* and *b*, horns or suckers; *c*, egg plainly visible in the body of the insect; *d*, the egg; *f*, winged form of the insect. All greatly magnified.

"In some localities of the south of France the vines are suffering from the ravages of a destructive insect, which has lately been noticed for the first time. M. E. A. Carrière has just published in the 'Revue Horticole' an extract from an article which M. J. E. Planchon contributed a short time ago to the 'Comptes-Rendus de l'Institut' (1868, p. 588). Here is the passage from the 'Revue':—

"I will here give a brief *résumé* of all I learnt about the habits of the *Phylloxera vastatrix* from a series of observations made on the spot, in three short visits to the south of France; also all I noticed with reference to the specimens which I kept in glass bottles during forty consecutive days.

"Its best-known form is that in which no trace of wings can be discovered. When the insect is about to lay its eggs (that is, in its adult female state), it forms a small ovoid mass, having its inferior surface flattened, its dorsal surface convex, being surrounded by a kind of fillet, which is very narrow when it touches the thoracic part of its body, which (formed by five rather indistinct rings) is hardly separated from its abdominal part of seven rings.

"Six rows of small blunt tubercles form a slight protuberance on the thoracic segments, and are found very faintly marked on the abdominal segments. The head is always concealed by the anterior

protuberance of the buckler; the antennæ are almost always inactive. The abdomen, often short and contracted, becomes elongated towards laying-time, and there can be easily seen one, two, or sometimes three eggs, in a more or less mature state.

“The egg sometimes retains its yellow colour for one, two, or three days after it has been laid; more often, however, it changes to a dull-grey hue. From five to eight days generally elapse before it is hatched. The duration of this period depends a good deal on the temperature. The quantity of eggs, and the rapidity with which they are produced, are probably determined by a variety of circumstances—the health of the insect, the quantity of nourishment it is able to obtain, the weather, and perhaps other causes. A female which had produced six eggs at 8 o'clock A.M. on the 20th of August, had fifteen on the 21st at 4 P.M.—that is, she laid nine in thirty-two hours. Other females lay one, two, or three eggs in twenty-four hours. The maximum quantity is thirty in five days. The eggs are generally piled up near the mother without any apparent order, but she sometimes changes her position so as to scatter them all around her. They have a smooth surface, and adhere lightly to each other by means of a slimy matter which attaches to them.

“Hatching takes place through an irregular and often lateral rent in the egg, the empty and crumpled membrane being found among the other eggs in different stages of hatching.

“During the first period of their active life—two, three, four, or five days, as the case may be—the insects are in an erratic state. They creep about as if they were seeking for a favourable situation. Their movements are more rapid than those of adults. They appear to inspect, as it were, with their antennæ the surface they travel over. The movements of the antennæ are generally alternative, and, if the comparison may be pardoned, are not unlike the two sticks of a blind man, which he uses to explore the ground he is about to tread.

“After a few days of this errant life, the young insects seem to fix upon a spot to settle in. Most frequently this is a fissure in the bark of a vine, where their suckers can be easily plunged into the cellular tissue, full of saccharine matter. If you make a fresh wound on the root by cutting off a little piece of the bark, you may see the *pucerons* range themselves in rows around the wound, and, once fixed, they apply to the root their antennæ, which appear like two small divergent horns. At this period of their life, about the 13th or 14th day after their birth, they are more or less sedentary; but they change their places if a new wound is made on the root, which promises a fresh supply of food.

“‘What sense is this which directs these subterraneous *pucerons* towards the place which is most suitable for them? It cannot be sight, as their eyes are merely coloured spots, and they creep as if they were blind. It cannot be hearing, because they seek no prey but a vegetable tissue. It is probably the sense of smelling; and one may well ask if the nuclei which appear enshrined in the last articulations of the antennæ are not the organs of this function, the seat of which has been so much disputed? Among these non-adult insects, attached by their suckers to the vine-root, are seen, here and there, some of middle size. Their colour is a deeper orange, the abdomen shorter and more squarely formed. These individuals are more sedentary than the others. I have sometimes imagined they might be wingless (apterous) males of the species; but as nothing has happened to confirm this very problematical hypothesis, and as I have seen undoubted females much resembling these examples in colour and form, I incline to the belief that there are no sexual differences among them. A kind of double moult precedes the adult state. The first takes place shortly after birth, the second after laying-time. Some uncertainty, however, hangs over the number of these changes, as the cast-off skins are often found mixed up with groups of *pucerons* of different ages, and it is difficult to distinguish them. On the morbid tuberosities of the fibrous vine-roots, or on the offshoots of the roots, the *pucerons* (perhaps better nourished) seem to pass more quickly through the different phases I have described; but, excepting that their colour is paler, they present no marked difference.

“‘The winged form of the *Phylloxera* might easily be taken for a separate species. The rare specimens which I have seen have all come from the *pucerons* nourished on the newly-attacked vine-radicles. In their infant (or it might be called their larva) state they resemble those which I have suggested may be males, but the buckler soon becomes more strongly marked than in these last; and a kind of band seems distinctly to define the separation between this and the abdomen. The sheaths of the wings, triangular-shaped and of a greyish colour, appear on both sides of the buckler. It is easy to predict the advent of a winged insect from this chrysalis. When one of these nymphæ is seen to quit its place and to crawl over the root, or up the side of the bottle where it may have been put, its transformation is near. Soon, instead of a sort of pupa, a beautiful little fly appears, whose two pairs of wings, crossed horizontally, are much larger than its body.

“‘It is impossible to doubt the identity of this insect with the *puceron* which formed one of the swarm on the vine-root. The

details of the structure of certain organs—the antennæ, claws, tarsi, and suckers—establish their identity.

“The horizontal position of the wings completely distinguishes the *Phylloxera* from the true aphids, whose wings are always more or less inclined upwards. The two larger wings, obliquely oboval and cuneiform, have a lineal areole on the larger basilar half of their outer edge; and this is enclosed in an interior “nervure,” which answers, I suppose, to the radial muscle. One single oblique nervure (or corneous division) is detached from this last, and reaches to the inner edge. Two other lines start from the end of the wing, and, becoming narrower as they proceed, advance towards the oblique nervure, but end before reaching it. These are not, perhaps, nervures, but rather folds, for I have observed them absent.

“The inferior wings, both narrower and much shorter, have a marginal nervure running from the base to the middle, but it loses itself in a gentle protuberance, which the wing shows in this place; a radial nervure runs parallel to the first, and disappears before it reaches the same spot.

“The eyes, black and (relatively) very large, are irregularly globular, with marked conical nipples; their surface is granular, but a pointed depression is observed in the centre of each glandule. A round eye-shaped spot occupies the centre of the forehead.

“Among fifteen winged specimens of the *Phylloxera* which have come under my notice, not one has presented any sexual difference. Almost all of them laid two or three eggs, and their death (which happened soon after) may have been caused by their imprisonment in the bottles. Their eggs resembled those of the wingless *Phylloxera*, and though they were only two or three in number, they completely filled the abdomen of the mother. They were easily seen by placing the insect under the microscope. I do not know how long the eggs remain before they are hatched, or if they always produce the winged form of the insect. It is probable that these winged individuals serve for the transportation of this insect plague to a distance; not that their wings would serve them for a rapid flight—they are too inactive, they move them very little, and in rising from the ground their horizontal position is preserved. My observations were, however, made under very unfavourable conditions, the insect being in a state of captivity; but I suppose that even in the natural state the wind is the principal agent for the dispersion of the *Phylloxera*, as it is for many of the insect tribe. In any case, the discovery of this form of the *Phylloxera* provided with wings, and evidently fitted for an aerial life, is sufficient to explain the hitherto embarrassing fact of the rapid

spread of the vine-plagues. As to the spread of the disease from one vine to another, the wingless *pucerons* may suffice for this, as, grouped in great numbers about the lower part of unhealthy vine-stems, they might easily attack the vines nearest them, even if they be healthy. It may be asked, in what manner these insects manage to travel from one vine-stock to another, and how they contrive to reach the fibrous roots of the newly-attacked stocks? Do they burrow under the soil; or do they not rather travel along the surface of the earth under cover of the darkness and coolness of night, and then, traversing the fissures in the bark, arrive in this manner at the extremities of the roots? This conjecture is a probable one, and the following experiment supports it:—

“In a case 1 yard long I placed some garden soil from Montpellier, a place entirely free from the *Phylloxera*. In this earth I carefully laid some pieces of vine-cane infested with wingless *pucerons*. I placed a handglass over each cane, and slightly raised the glass on one side in order to allow the insect to creep out. At three centimetres' distance from the pieces of cane I put some fragments of root from a healthy vine, on which I had made fresh wounds. In twelve hours the following results were obtained: Three *pucerons* had found their way from one of the vine-caness to the nearest piece of vine-root. Some days after, twenty young *pucerons* occupied the same fragment. A few insects were to be found on the other fragments. One piece of root had attracted none, but the vine-cane nearest to it had very few insects upon it which were capable of changing their places.

“A similar experiment has been made by M. Frédéric Leydier at the farm of Lancieux, near Sigondas (a part of the country already infested by the *Phylloxera*), and by another person near Sorgues. The results of these experiments have not been satisfactory; but this does not prove that, under other conditions, or with a greater amount of perseverance, they might not have been successful. It is fortunate that this new enemy to the vine attacks it (in the first instance) at the base of the stem, and not underground at the fibres. As it is, a thorough dressing of the bottom of the stem with coal-tar will probably prove an insurmountable obstacle to the progress of this destructive insect; but were the case otherwise, it would be very difficult to get down deep enough to reach an enemy so well protected by the depth of the soil.”

N.

The only remedy that has yet been discovered for this dreadful pest, is to root out the affected vines, remove all the soil they

grew in, paint all wood-work, and lime-white all the stone or brick-work with hot lime ; then make up new borders, and plant fresh vines. This has always proved effectual in getting rid of the evil, as far as has come to my knowledge ; for, happily, I never myself saw or had any practical knowledge of the insect.

It seems quite certain that it cannot live on any other plant than the vine ; yet caution should be used by all who get plants taken out of the borders of foreign nurseries, where vines are grown in the open borders, lest bits of the vine-roots should be amongst those of other plants, and by that means it may be propagated in this country. It might easily be "stamped out"—to borrow a phrase from the treatment of rinderpest—if care were taken on the part of nurserymen not to send out plants affected by it. And, no doubt, for the future this will be attended to ; for I feel certain that the firms who sent out vines affected were no way aware they were so, and had they been, would never have sent them out, no matter what the loss to themselves might have been.

One cannot but regret to observe how much precious time the French Government is wasting in seeking for and propounding absurd remedies for this—to the French nation—dreadful scourge, while it is quite certain there is but one remedy, which they seem to avoid,—that of destroying all the vines that are affected, and also a margin of healthy ones round the affected ones, and cropping the land for some years with wheat and other crops, till the roots of the vines are all gone, and the insects with them, when the land could be replanted with vines. An assessment on the healthy districts could be made to compensate those whose vines had to be rooted out.

The nation will find, to its cost, that nothing short of this will meet the case ; and every hour its application is delayed will make the remedy the more costly.

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